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GRAF LEAD-ZINC RECONNAISSANCE
SOUTHERN ROCKY MOUNTAINS
N.T.S 82 N/SE, 82 K/NE, 82 J/W, 82 G.NE

C. Graf

November 1977

VOLUME I

NTS 82 N/K/J/G.

MINORA INLET

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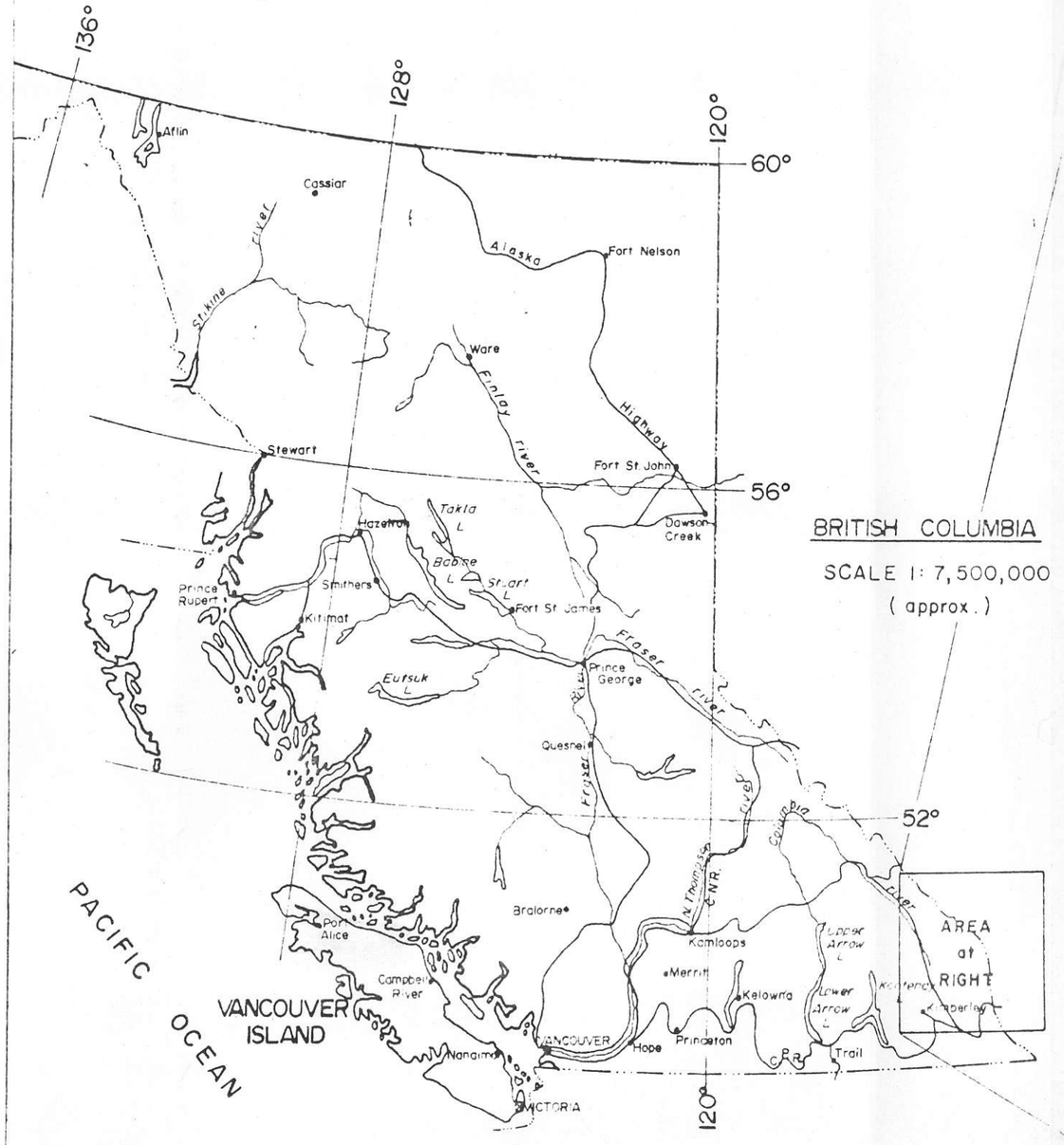
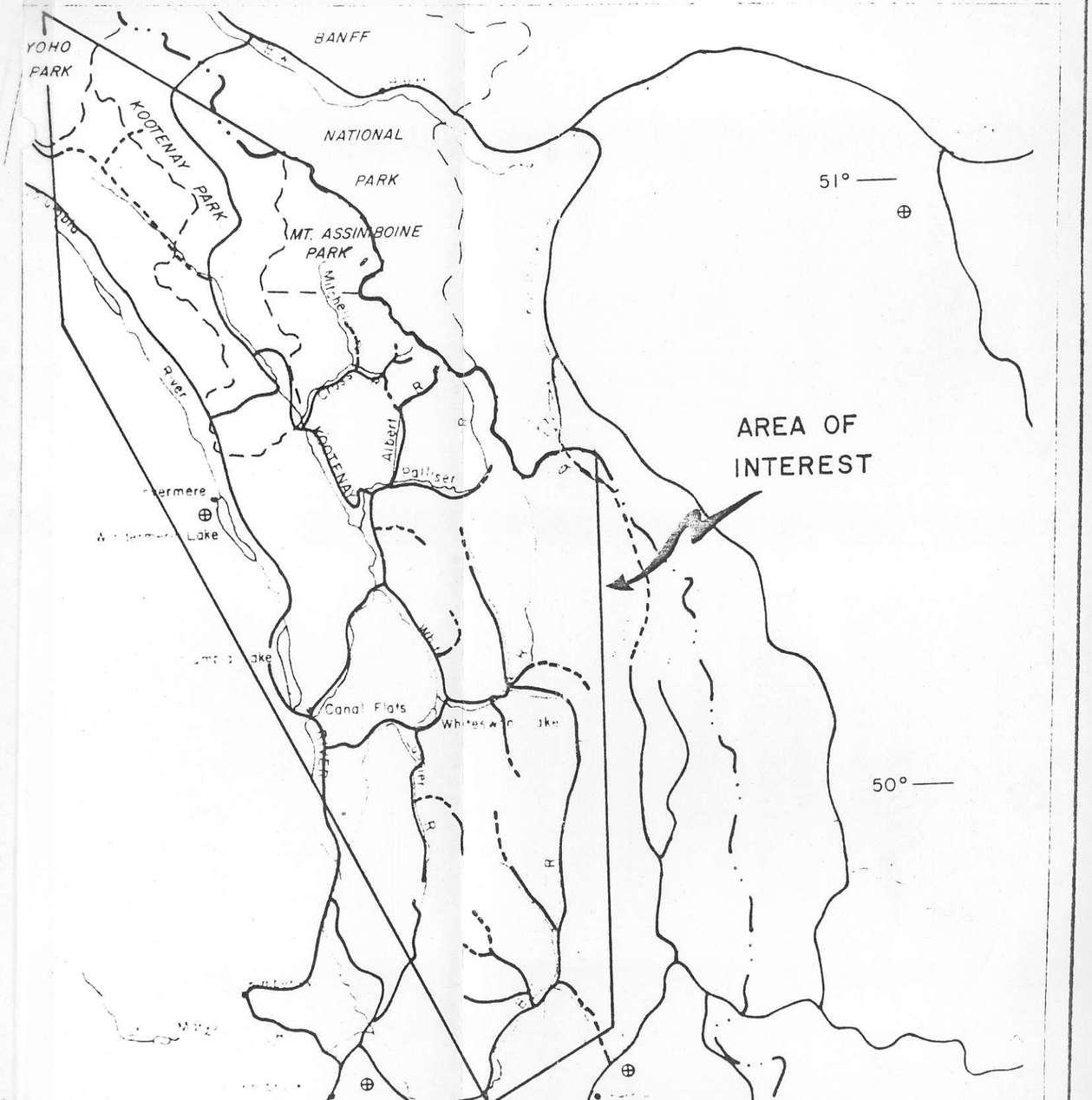
S U M M A R Y

An exploration concept for Mississippi Valley type Pb-Zn mineralization in the Southern Rocky Mountains between Banff and Assiniboine Parks, and Crowsnest Pass, was brought to Riocanex by the writer in the fall of 1976. A program was organized by Riocanex and carried out by the writer in the summer of 1977. Field work consisted of general mapping, silt sampling and prospecting two separate stratigraphic units, the middle Cambrian Cathedral dolomite formation, and a sequence of middle to upper Devonian carbonates. Eight claims (127 units) were subsequently staked in the Cathedral Formation along the north-west side of the Royal Group Mountain Range, to cover two Pb-Zn showings and a series of Pb-Zn anomalies which occur on strike between them. Two claims (26 units) were also staked in Devonian carbonate rocks at the head of Rock Canyon Creek to cover a fluorite showing and adjacent fluorite float contained in talus slopes. This report describes and discusses the general geology, geochemistry, topography, accessibility, and mineral occurrences of the area.



BRITISH COLUMBIA

SCALE 1: 7,500,000
(approx.)



Park Boundaries

Main roads and highways

Four wheel drive roads

⊕ Aircraft available , helicopter bases

SCALE 1: 1,000,000 (approx.)

Km 10 0 10 20 30 40 50 60 70 Km

RIO TINTO CANADIAN EXPLORATION LTD

GRAF ZINC

LOCATION MAP

APRIL 78 | C.G./y.m. | DWG. L.-6523

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1. INTRODUCTION

It has long been recognized that Mississippi Valley type mineralization occurs in middle Cambrian carbonates within Banff and Yoho National Parks, the Monarch-Kicking Horse Pb-Zn orebody being an impressive example (Ney, 1954). Two other nearby occurrences of the same type are the Hawk Creek and Baker Creek deposits. (Henderson 1951, Evans et al, 1968). A significant, but little known Mississippi Valley type deposit lies in the Upper Devonian Palliser Formation, just on the Alberta side of Mt. Gass, at the head of the Oldman River (DWG. G-8603). A good zinc showing occurs in middle Devonian recrystallized dolomites at Munroe Lake, and numerous oil wells have intersected ore grade Pb-Zn within Devonian carbonate reefs in South Central Alberta (Haites, 1960).

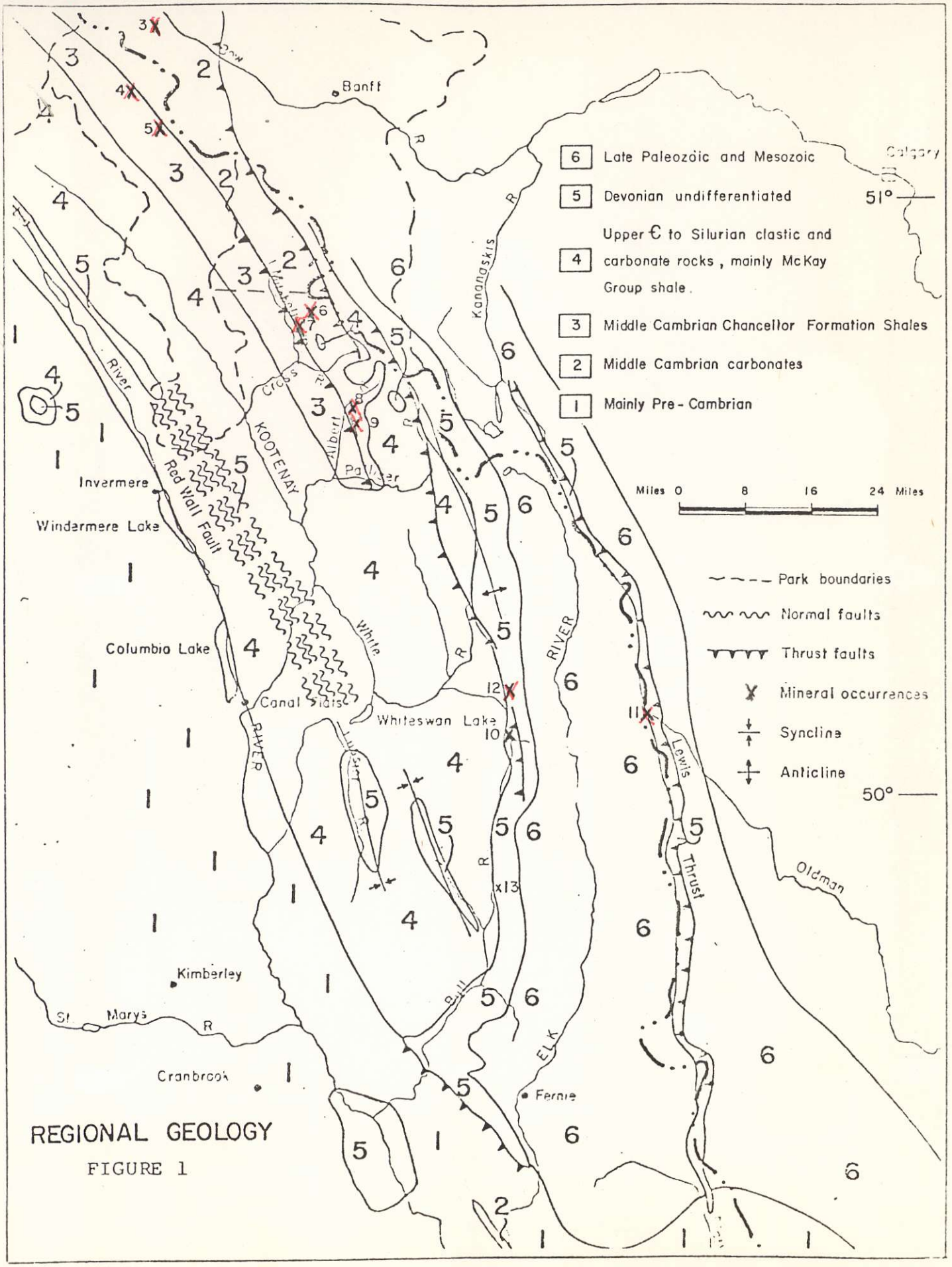
It was believed that middle Cambrian and Devonian carbonate rocks continued into the Rocky Mountains south of Banff and Yoho Parks, although the area has never been geologically mapped. If the rocks did exist there, it was thought that they would likely contain deposits of Mississippi Valley-type Pb-Zn, because of the numerous examples, cited above,that have been found in the surrounding area.

A project, proposed and then supervised by the writer, was launched by Riocanex in 1977 to investigate these possibilities. The work, results and claims staked, within the Area of Interest shown in DWG. L-6523 are subject to an agreement between the writer (Graf) and Riocanex dated 25 April 1977. Certain areas subsequently recommended also remain subject to the agreement.

The project was divided into two sections or target areas: one dealing with middle Cambrian stratigraphy, and one dealing with Devonian stratigraphy. These two groups of rocks outcrop in totally separate areas, and are geologically unrelated, making it logical to have investigated them separately.

Geological mapping delineated a target area of Cathedral Formation dolomite south of the Assiniboine Park boundary (DWG. G-8602-1), which was subsequently stream-silt sampled and prospected. Four Pb-Zn showings and a dozen Pb-Zn silt-sample anomalies were discovered.

Devonian rocks,were found by mapping to,occur in a belt along the floors and east sides of the Palliser, White and Bull river valleys (Figure 1). This area was prospected and stream silt sampled without finding any Pb-Zn mineralization although an old zinc showing occurs in the belt at Munroe Lake. Numerous silt samples anomalous in zinc occur all along the belt in approximately the same stratigraphic position. A fluorite showing was found north and on strike from the zinc showing at Munroe Lake.



REGIONAL GEOLOGY

FIGURE 1

TABLE I

LIST OF MINERAL OCCURRENCES SHOWN ON FIGURE 1

1. Monarch and Kicking Horse Mines - Zn, Pb, Cu in Cathedral Formation Dolomite.
2. Baker Creek Deposit - Pb in Cathedral Formation Dolomite.
3. Eldon Deposit - Pb, Zn, Cu in Lower Cambrian Argillaceous calcareous Rock.
4. Paint Pots Ochre Field - Pb, Zn in Iron Oxide Mineral Springs draining the Chancellor Formation.
5. Hawk Creek - Zn, Pb in Chancellor Formation Limestone.
6. C-1 Showing - Zn, Pb in Cathedral Formation Dolomite.
7. C-2 Showing - Zn, Pb in Dolomite Float Boulders.
8. SHAG Property - (C-3 Showing) - Zn in Cathedral Formation Dolomite.
9. SHAG Property - (C-4 Showing) - Zn, Pb in Cathedral Formation Dolomite.
10. Munroe Showing - Zn in Devonian Harrogate Formation Dolomite.
11. Oldman River - Zn, Pb in Devonian Palliser Formation Dolomite.
12. Deep Purple - F, Ba in Devonian Burnais Formation Carbonates and Evaporites.
13. Bull River Fluorite - F, Ba in Devonian Burnais Formation Carbonates and Evaporites.

2. LOCATION AND ACCESS

The area of interest, (DWG. L-6523), is a belt of the Rocky Mountains approximately 125 km (75 mi) long and 20 km (12 mi) wide, lying immediately south and east of Mt. Assiniboine Provincial Park. The N. T. S. divisions are the west halves of 82J and 82G. The main access roads are from the town of Canal Flats, at the south end of Columbia Lake, or down the Kootenay Valley, from the Radium - Banff highway, along the old Settlers road. Logging roads suitable for two-wheel drive vehicles, branch off these main roads and pass to the heads of almost all valleys (DWG. L-6523). Helicopter transportation (Jet Ranger), is readily available through Okanagan Helicopter bases at Cranbrook and Golden.

3. TOPOGRAPHY

The area is very mountainous, with elevations ranging between 4500 ft. and 11,000 ft. making traverses difficult and talus prospecting the only way to examine the rocks in most areas. The valley bottoms are generally covered with a few hundreds of feet of glacial drift. Tree cover varies between sparse scrub timber and grass on the peaks, to dense mature forests in a few valley bottoms. Generally the underbrush is sparse to moderate.

4. PREVIOUS WORK

a) Much of the Rocky Mountains directly south of Banff Park remain geologically unmapped. The only relevant publications are G. S. C Paper 58-11 and Map 1960-11, Fernie west half map area, and G. S. C. Paper 54-7 and Map 24-1958, Canal Flats map area, both of which partially cover the southern extremities. To the north, the nearest mapped area lies 30 km (19 mi) away. A useful, but sketchy, and partly out of date discussion of the geology in this area was published in a 1954, ASPG Guidebook (North) and Henderson, 1954.

b) Silver Standard Ltd., has trenched and drilled a Zn showing in the middle Devonian section at Munroe Lake.

c) Placer Development Ltd., has done extensive bulldozer work and drilling in massive magnesite beds of the Cathedral formation along the east sides of the Mitchell and Cross Rivers.

d) No other showings or mineral occurrences have been reported in the area.

5. WORK BY RIOCANEX IN 1977

The two and one half months of summer work was split into two separate parts, the first of which was an exploration of middle Cambrian carbonate rocks, and the second a similar investigation of Devonian carbonates. The area worked wae

the central part of the Rocky Mountains, between Mount Assiniboine Park and Sulfur Creek on the lower reaches of the Bull River. The approach used in both target areas, was to first delineate the outcrop areas of the prospective formations, and then investigate them with a program of geochemical stream silt sampling and prospecting.

The crew consisted of four persons, including the writer, who was the only one with an adequate geological background to interpret geology and carry out the mapping. Work during the first month (June) was conducted from tent camps using two trail bikes and a four-wheel-drive vehicle to cover the easily accessible sections of both target areas. From July 1st. to 15th, the base was moved to a motel in the town of Invermere, from which transportation was by helicopter to the remote, inaccessible parts of the target areas still left unexplored. Owing to the success of the project, a further 10 days of helicopter time was allotted, and the base remained in Invermere until the end of July. A further two weeks of work was conducted by the writer and his wife, following up anomalous areas with prospecting, while the other two crew members moved on to another Riocanex project. Work was finally completed on August 15th.

During the two and a half month long program, the outcrop areas of both the middle Cambrian and Devonian rocks were recognized and delineated on topographic maps. A total of 600 geochemical samples, mainly stream silts, were collected, 257 from middle Cambrian stratigraphy, 225 from Devonian stratigraphy and 93 from areas underlain by Ordovician rocks.

A group of 8 claims (127 units), called the SHAG property was staked on middle Cambrian rocks to cover two Pb-Zn pyrite showings and a series of silt sample anomalies that occur on strike between them. Two claims (26 units), called DEEP PURPLE and CANDY, were staked to cover a fluorite showing in Devonian rocks at the head of Rock Canyon Creek, along the White River. A week was spent, by the writer and his wife, studying the geology around the Munroe zinc showing of Silver Standard Mines Ltd., to determine whether claims should be staked on open ground to the north. Approximate costs for the entire project in 1977 were $74,000.00.

6. RESULTS OF 1977 FIELD PROGRAMME

6.1 Mapping

The most important part of the 1977 work was recognizing the middle Cambrian and Devonian formations in the field and delineating their areas of outcrop on topographic maps, thereby outlining areas for exploration. The results of this mapping are shown on DWG.G-8603 at a scale of 1:250,000. (In pocket).

6.2 Geochemistry

Twenty-five of the 257 samples taken from the middle Cambrian were anomalous in Pb,Zn or both, while forty-two samples were anomalous in Zn from the 225 collected over Devonian stratigraphy(DWGS. G-8600,4,G-8601-4) Only one geochemical silt sample anomaly has to date led to a Pb-Zn showing, though the majority have not

yet been followed up. Three of the four showings were found by prospecting alone, and would not have been shown up by stream silt geochemistry. In the writer's opinion, thorough prospecting is a far better tool than relying on geochemical silt samples to locate Pb,Zn showings in a reconnaissance programme over carbonate terrain. On a detailed programme, over a property however, geochemical soil sampling with a close sample interval would be a more valuable tool than prospecting, especially where outcrop is poor.

6.3 Showings

Four Pb,Zn showings labelled C-1, C-2, C-3 and C-4 were discovered in the middle Cambrian target area (Cathedral Formation) in 1977 (DWG. G-8603). The Shag claims (127 units) were staked to cover the C-3 and C-4 showings as well as a number of anomalous silt sample locations along strike between them (Figure 3). One fluorite showing was found in the Devonian target area and subsequently staked as the DEEP PURPLE and CANDY claims. The Munroe Lake zinc showing of Silver Standard Ltd., was carefully studied, but no adjoining claims were staked.

6.3.1 C-1 Showing

This showing is contained in a gossanous crackle brecciated, silty, dark coloured dolomite within the upper part of the Cathedral Formation. Where sampled the mineralization is very low grade, with grab samples averaging 0.5% Zn and 0.1% Pb (Appendix 1). The brecciated gossanous zone is approximately 6.1 m (20 ft.) thick, and can be traced along strike, by following pieces of goethite float, for at least 1.6 km (1 mile), to where a soil sample, highly anomalous in zinc and lead, was taken. Sphalerite and galena are only rarely seen, and occur as disseminations in white sparry dolomite fracture-fillings. It is not known if any well mineralized sections exist anywhere along the gossanous zone, as outcrop is poor and fresh rock uncommon.

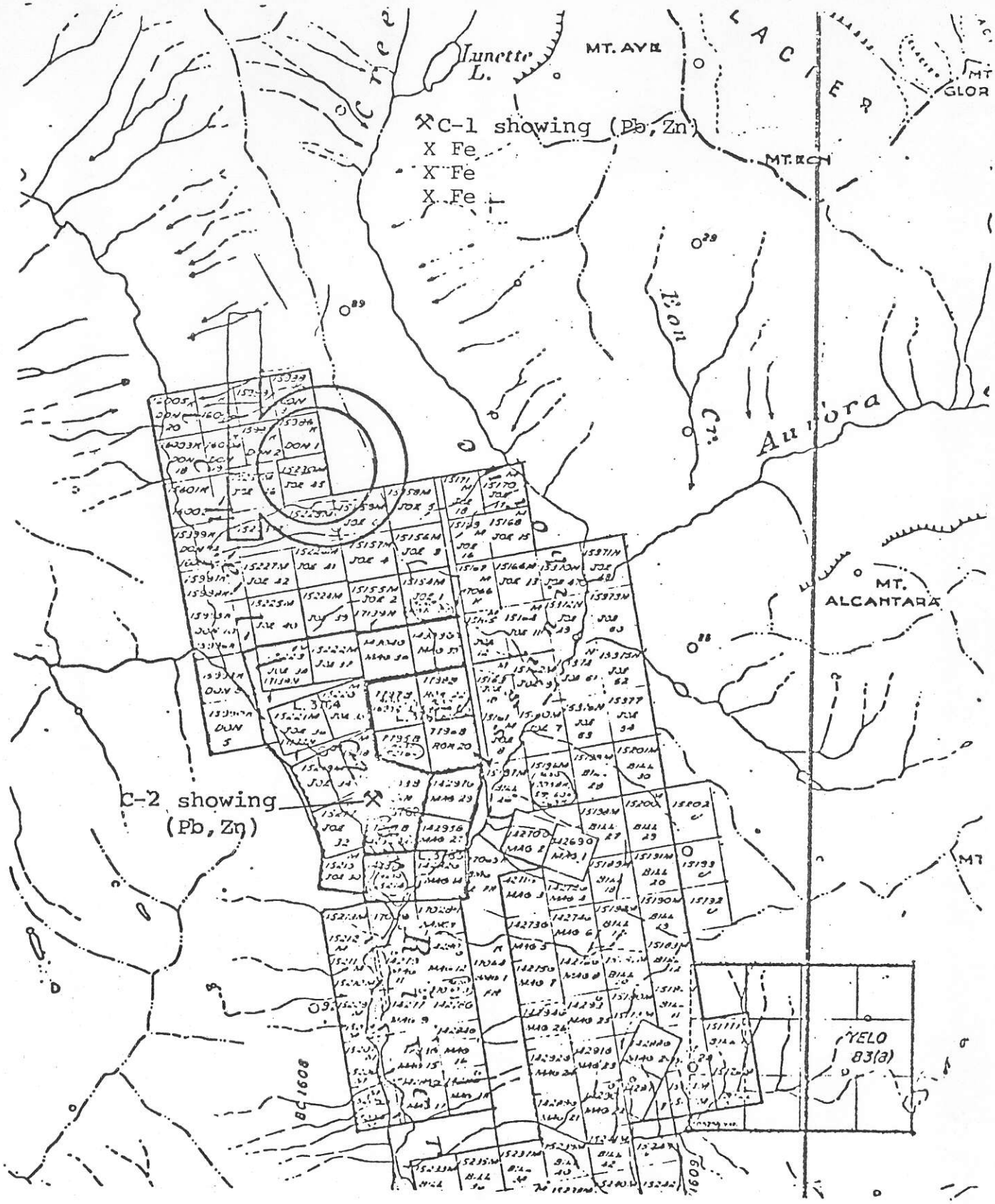
6.3.2 C-2 Showing

This showing consists of numerous hydrozincite coated boulders and rocks (5% of the total number of pieces) occurring in a 30 m (100 ft.)long road cut in a gravel deposit. At no other point along this road, were any other hydrozincite coated pieces found. As yet the source of the mineralization at the C-2 showing, is unknown, but it most probably lies within the magnesite claim group (Figure 2) worked by Placer development. The most common mineralized rocks contain

white hydrozincite coatings with no apparent sphalerite inside, indicating the source of zinc to be elsewhere though local. Two fist sized pieces of almost solid sulfides were found, one of which shows well developed botryoidal textures of sphalerite and marcasite. A large 10 kg boulder was found that contained 80% of 5 cm (2 in) long breccia fragments of many lithologies, cemented by 10% fine-grained, non-sparry grey dolomite, and 10% fine-grained pyrite and sphalerite. This breccia resembles that of a trash zone in a karst cavern and, coupled with the sample which shows textures of botryoidal sphalerite, makes the occurrence very interesting and important.

6.3.3 C-3 Showing

This showing is covered by the SHAG claims (Figure 3). The mineralization occurs in a very steep cliff face above a long talus slope, and consists of a series of sphalerite-bearing, vertical, solution breccia channels and fracture zones, about 15 cm (6 ins.) wide, spaced randomly across a width of 9 m (30 ft). Most of the mineralization was found in the talus, as it was too steep to prospect very much of the cliff. At least 3 types of sphalerite, reddish-orange, black and honey coloured, were found cementing breccia fragments in typical Mississippi Valley fashion in the talus. Only the reddish orange variety has been traced to outcrop,



Location of C1 and C2 showings and Magnesite Claims optioned by Placer Development Corp.

FIGURE 2

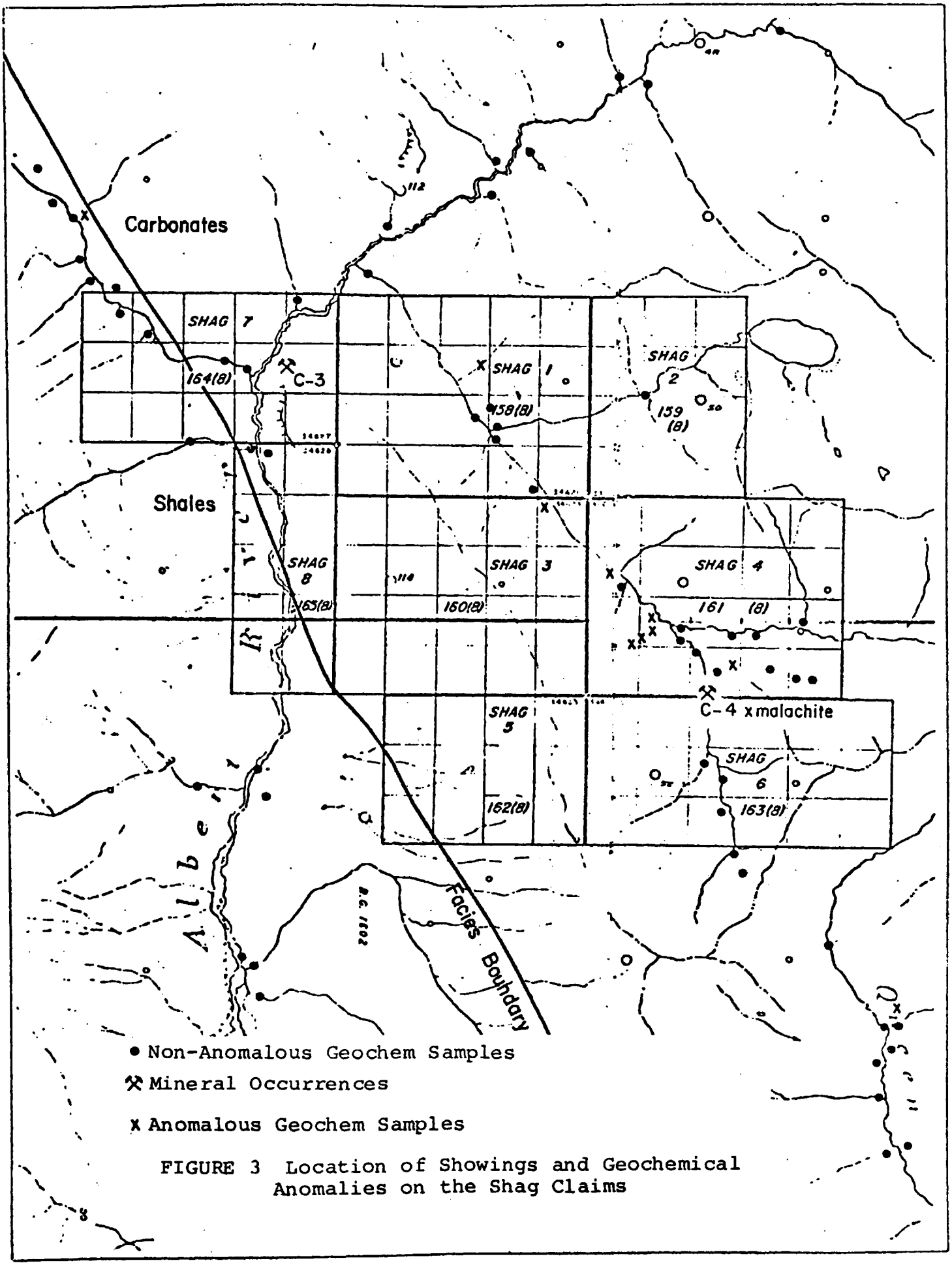


FIGURE 3 Location of Showings and Geochemical Anomalies on the Shag Claims

where it occurs in the vertical solution channels described above. Five grab samples from the talus assayed between 5% and 27% zinc, with no lead.(Appendix 1).

6.3.4 C-4 Showing

This showing also is covered by the SHAG claims (Figure 3). The mineralization occurs in a creek bed, and in miniature cliffs along each side. Mineralization was observed across a maximum stratigraphic thickness of 1.2 m (4 ft.) but is concentrated in a much narrower zone about 0.3 m (1 ft.) thick. Sphalerite is the most common sulphide, with both reddish and honey coloured varieties occurring. Lesser amounts of galena and pyrite are usually present. White sparry dolomite is present in minor amounts. Assay values varying between 4% to 40% zinc, and .45% to 9% lead with 0.15 oz/ton silver have been obtained from grab samples (Appendix 1). A zone approximately 0.3 m (1 ft.) thick that contains at least 60% sphalerite and a few percent galena, occurs on the west side of the creek. This zone is horizontal, and conformable to bedding. It is not certain whether the mineralization is a replacement of limestone, or a matrix in a breccia zone, as the mineralized pieces show textures supporting both possibilities. It is likely that the two processes occurred in conjunction with each other.

6.3.5 DEEP PURPLE FLUORITE SHOWING

This showing (Figure 4) occurs in Devonian carbonate-evaporite rocks and consists mainly of a deposit of purple and white fluorite in boulders, some larger than.3 m (1 ft.) across, scattered along a

bulldozer road over a distance of approximately 60 m (200 ft.). Assay values from 5 grab samples gave results as high as 32% fluorine and 7.7% barium, with lesser amounts of strontium and lead. (Appendix I). Similar boulders have been found scattered along other bulldozer roads up to 0.4 km (1300 ft.) away, and probably come from separate sources because of their random locations with respect to each other. Numerous small pieces of rusty oxidized float containing minor purple fluorite, occur along many bulldozer roads, and in one place were traced to outcrop. There is a lot of fine-grained pyrite in these rocks, and many hillsides are rusty coloured because of iron oxides in the soil.

6.3.6 Munroe Showing

This showing is covered by claims belonging to Silver Standard Mines Ltd. (Figure 4). The deposit occurs in a recrystallized dolomite breccia? within the middle Devonian Harrogate Formation. The dolomite breccia? unit is at least 6.1m (20 ft.) thick on the property and contains numerous irregular blobs and wisps of white sparry dolomite generally about 1.3 cm (0.5 in.) across, in a matrix of subhedral to euhedral grains of dolomite approximately 1 mm across. Subhedral to euhedral disseminated grains of light yellow coloured sphalerite occur within the dolomite matrix in places. Grades are low, with a chip sample across 2.1 m(7 ft.) assaying slightly less than 2% Zn and no Pb.(Appendix I). A 92 m (300 ft.) long trench has exposed patchy, but generally continuous mineralization for its full length.

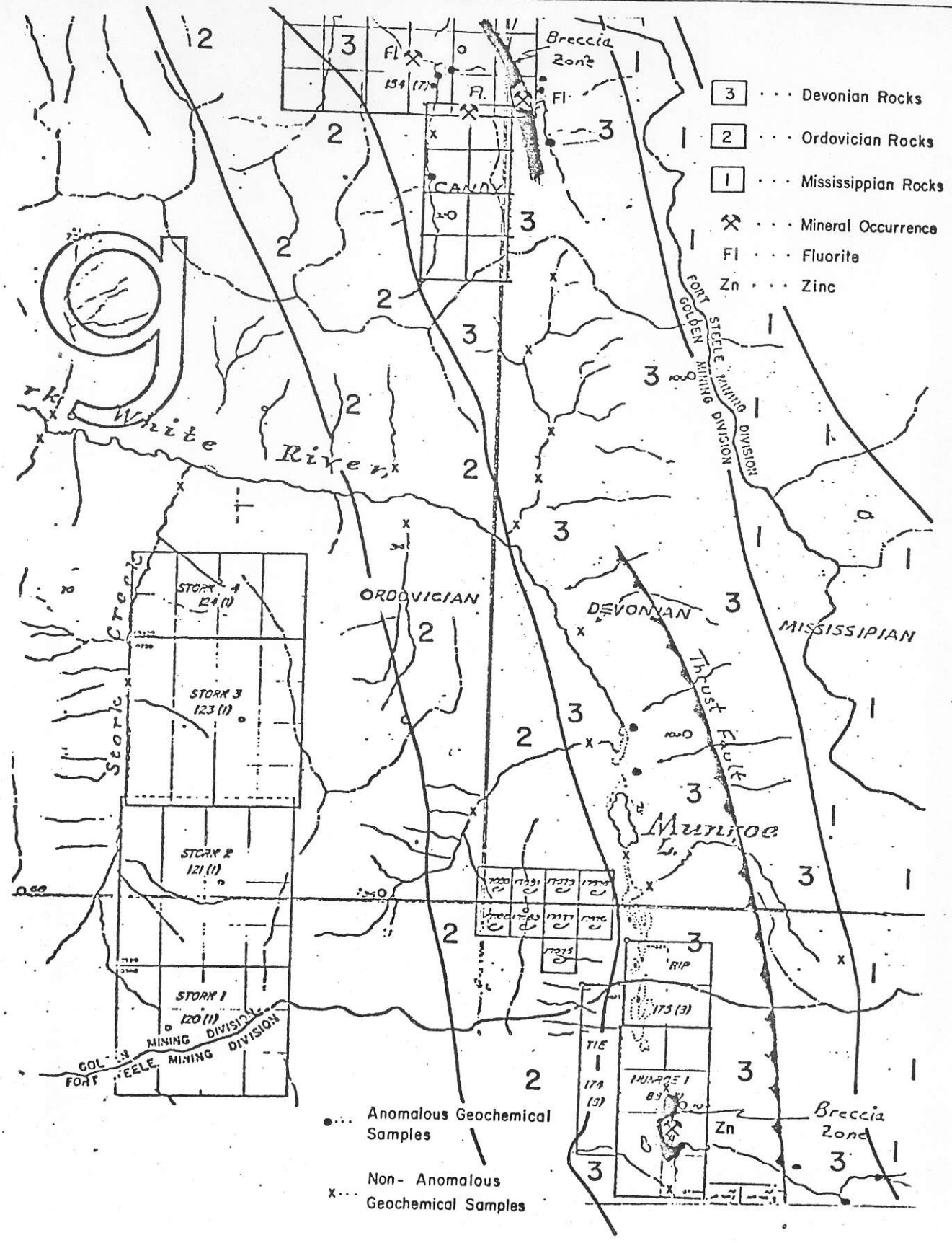


FIGURE 4 Location of Showing and Geochemical Anomalies on the Deep Purple, Candy and Monroe Claims

6.4 Claims Staked

Based on the discovery in the C-3 and C-4 showings of lead/zinc mineralisation the claims SHAG 1-8 (127 units) were staked and recorded (by contractor) 15 August 1977.

The occurrence of purple fluorite in apparently rich concentrations prompted the staking and recording of the DEEP PURPLE claim (18 units) on 28 July 1977 and later on 13 October 1977 of the contiguous CANDY claim (8 units).

All claims are held by Riocanex and are subject to the agreement with the writer.

7. GEOLOGY

7.1 Major Structural Subdivisions

The Rocky Mountain geological and physiographical province can be divided into a number of distinct and generally parallel subprovinces, which are:

1. Foothills subprovince.
2. Front Ranges subprovince.
3. Main Ranges subprovince.
4. Western Ranges subprovince.

The Main Ranges subprovince can be further divided into clearly defined eastern and western sectors.(Figure 5).

The four major subprovinces stretch continuously in a broad belt from Mt. Robson in Jasper Park, to the Albert River. South of the Albert River, the eastern sector of

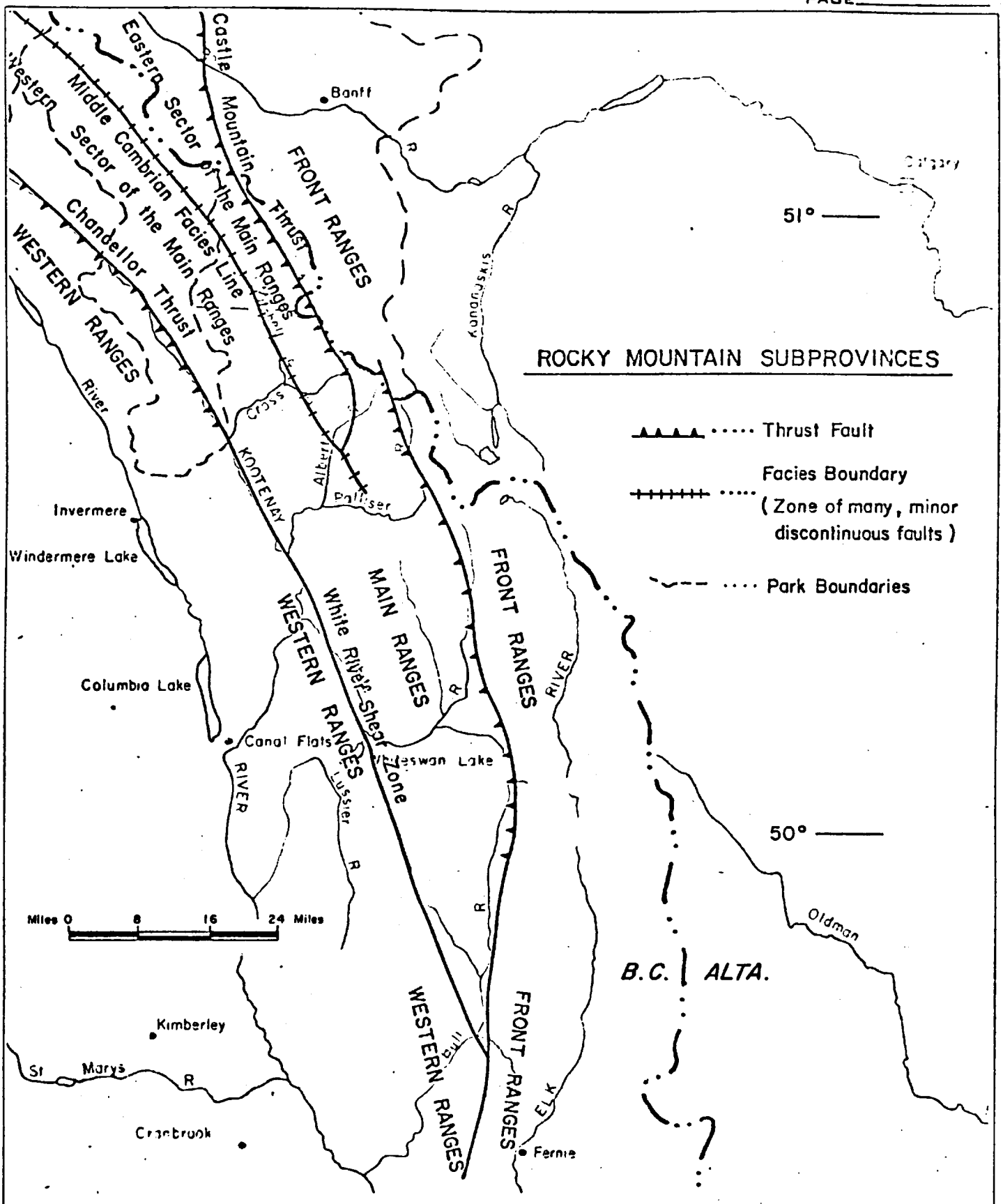


FIGURE 5 Rocky Mountain Sub-provinces.

the Main Ranges subprovince disappears, while all the others continue towards the International Boundary.

Each subprovince contains its own distinguishing features of topography, structural style and stratigraphy. Major faults or fault zones separate one subprovince from another. Further discussion will be confined to the Front and Main Ranges subprovinces, because the summer's work of 1977 was contained solely within them.

The Front Ranges subprovince comprises a series of subparallel, west-dipping thrust blocks that lie between the Foothills and the Main Ranges. The eastern margin is marked by the McConnell fault, along which Paleozoic beds have been thrust eastward over Mesozoic formations. The western margin of the subprovince is the Castle Mountain thrust fault and its southern extensions.

South of Banff Park, the eastern part of the Front Ranges is dominantly Devonian and Mississippian carbonates, with a segment of Cambrian to Silurian carbonates and shales in the west. The contact between the two belts of rocks lies along the Palliser, White and Bull Rivers. The lack of Devonian and Mississippian rocks along the western side of the Front Ranges, is undoubtedly an erosional rather than a non-depositional feature, as evidenced by the existence of these rocks even farther west in a number of fault and fold structures within the Main and Western Ranges. Structures within the Devonian and Mississippian carbonate rocks are dominantly thrust blocks and broad folds. In contrast the less competent

Mississippian rocks further east, as well as those of Cambrian to Silurian ages in the west, are generally deformed into extremely tight kinks and folds with numerous associated minor faults. South of latitude 50^{o} 30' N, the structure of the entire subprovince becomes quite complex.

The Main Ranges subprovince is a belt of relatively undisturbed rocks lying along the continental divide from Mt. Robson south to the Albert River. It is bounded on the east by the Castle Mountain thrust fault, and on the west by the Chancellor fault. It comprises an eastern sector of dominantly middle Cambrian massive carbonate units, and a western sector of less massive facies-equivalent shales. The lithoiogical differences between the two sectors is due to a spectacular facies change, across which approximately 2440 m (8000 ft.) of carbonates, comprising all of middle Cambrian time, give way to shale equivalents. Both sectors contain broad open folds, and are separated by a narrow complex zone of thrusting and tight folding that lies along the shale side of the facies boundary. Folding is much more prevalent in the western sector than in the eastern one. Small scale normal faults are common in the carbonate rocks, while the shale equivalents are intensely sheared.

Due to a number of factors including southerly plunge, loss of the middle Cambrian massive carbonates across facies changes and possible major faults, the eastern sector of the main ranges does not extend south of the Albert River. The western sector of the main ranges gradually narrows until it is finally truncated at Fernie between converging structures of the Western and Front ranges subprovinces. South of the Albert River it contains mainly shales and

and thin limestones of Upper Cambrian to lower Ordovician age.

7.2 Geological and Depositional History

The area lies near the western edge of the cratonic boundary. During Helikian time, over 9450 m (31,000 ft.) of sediments, known as the Purcell System, were accumulated in a slowly subsiding aulacogen that developed along this cratonic margin. Sedimentation began with deeper water turbidites, argillites and quartzites, gradually being succeeded by shallow water clastics, and finally much thin bedded carbonate. The Purcell system is made up of two series, a lower on which contains deep water clastics and is more commonly intruded by dioritic sills and dikes. The upper series formed in shallower water, and contains many dolomitic carbonates, and the extensive andesitic Purcell lava. Regionally the two series are time equivalent.

An unconformity, due to the East Kootenay Orogeny (800 my), removed great thicknesses of Purcell rocks from most of the area. Overlying this unconformity is a thick succession of Hadrynian conglomerates, quartzites and slates known as the Windermere System. In adrynian time, the area presently south of latitude 50° was an emergent land mass known as Montania, and contained uplifted Purcell strata. Erosion of these beds provided a source for the Windermere rocks, which formed as huge submarine fans on the down thrown (north) sides of large east-west trending block faults. Accordingly, the Windermere rocks thin northward away from the submarine fault-formed scarps. Windermere deposition began with the East Kootenay Orogeny, and continued until Cambrian time.

Further tectonic disturbances evidenced by another major unconformity, mark the beginning of the Cambrian era. A new land mass called the Windermere high, formed in the present location of the Rocky Mountain Trench, at latitude 50° 30' N, and shed clastic rocks both east and west during an early Cambrian transgression (Figure 6). Montania became more extensive at this time, resulting in much early Cambrian coarse clastic deposition, mainly along its western margins (Figure 7). Coarse sand deposition gave way to a phase of finer grained and more calcareous sedimentation before the close of early Cambrian time and finally to massive carbonate deposition during the middle Cambrian (Table 2). Apart from these two eroding highlands, the most important Cambrian geological control was the development of a major northwest-southeast trending facies front, which began in early middle Cambrian time, and persisted with a few lateral translations until lower Ordovician time (Cook, 1972). This boundary almost continuously separated massive carbonates on the east from fine grained shales on the west, while over 3660 m (12,000 ft.) of sediment was accumulated (Figure 7).

Formations of middle to Upper Ordovician and Silurian ages are not widespread in the area and it is difficult to develop a clear geological picture of this time period. It is characterized by the presence of numerous disconformities and unconformities within 915 m (3000 ft.) of shelf clastic and carbonate rocks. Facies fronts have been inferred to separate carbonates from clastics along boundaries in almost the same position as those of Cambrian time. (Norford, 1967.)

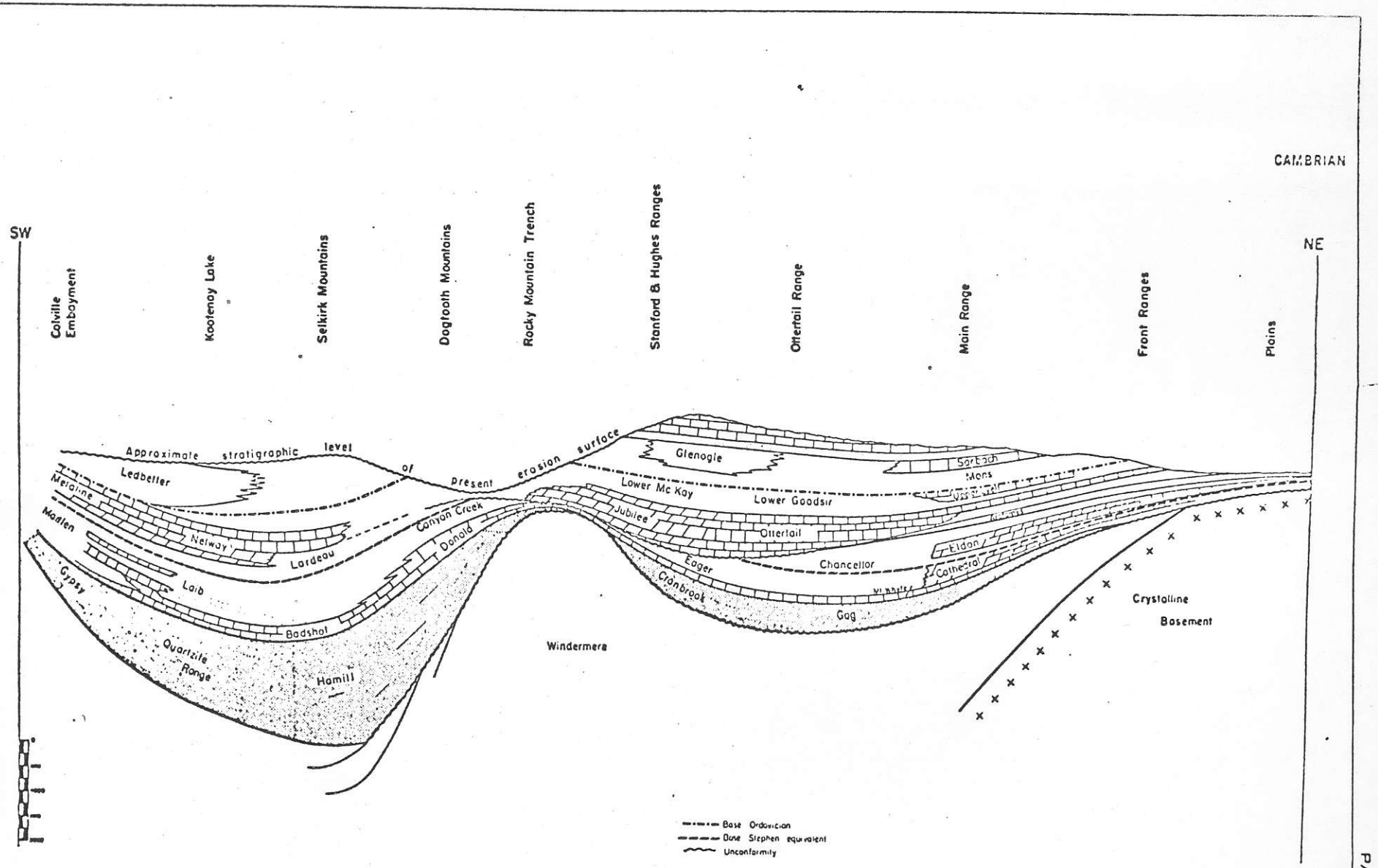


FIGURE 6 Stratigraphic reconstruction of the Cambrian of the Cordillera (from North, 1964)

A major unconformity marks the base of the Devonian succession throughout both the southern and northern Rocky Mountains. In the southern Rockies, Devonian rocks rest on many different formations, which vary in age from Silurian to pre-Cambrian. An angular unconformity is only obvious in a few exposures, showing that the erosion surface must have been of low relief, and only broadly folded, if at all. The Devonian rocks have not been well studied in the area, and therefore the facies boundaries and other aspects of their depositional basins are unknown. The island of Montania was finally submerged in middle Devonian time.

The basal Devonian is often marked by a thin sequence of red-bed rocks. Their lithologies vary from place to place, but are generally reddish conglomerates, quartzites, or shales overlain by sandy dolomite beds. Vesicular volcanic rocks occur locally.

Overlying the basal unit is a middle Devonian sequence of carbonates, the lower part of which contains extensive deposits of pure primary bedded gypsum up to 275 m (900 ft.) thick. Highly fossiliferous reefal? carbonates, shales and sandstones of upper Devonian age conformably overly the middle Devonian rocks. The reefal? facies can be correlated in age with those of the Leduc oil field in Alberta (Figure 8). Massive, cliff forming, fossiliferous carbonates, totalling over 1373 m (4500 ft.)thick comprise the remainder of the Devonian, as well as the Mississippi strata. These massive, carbonate bank-formed rocks are totally distinct from any others within the southern Rockies,except perhaps those massive carbonate formations of middle Cambrian age.

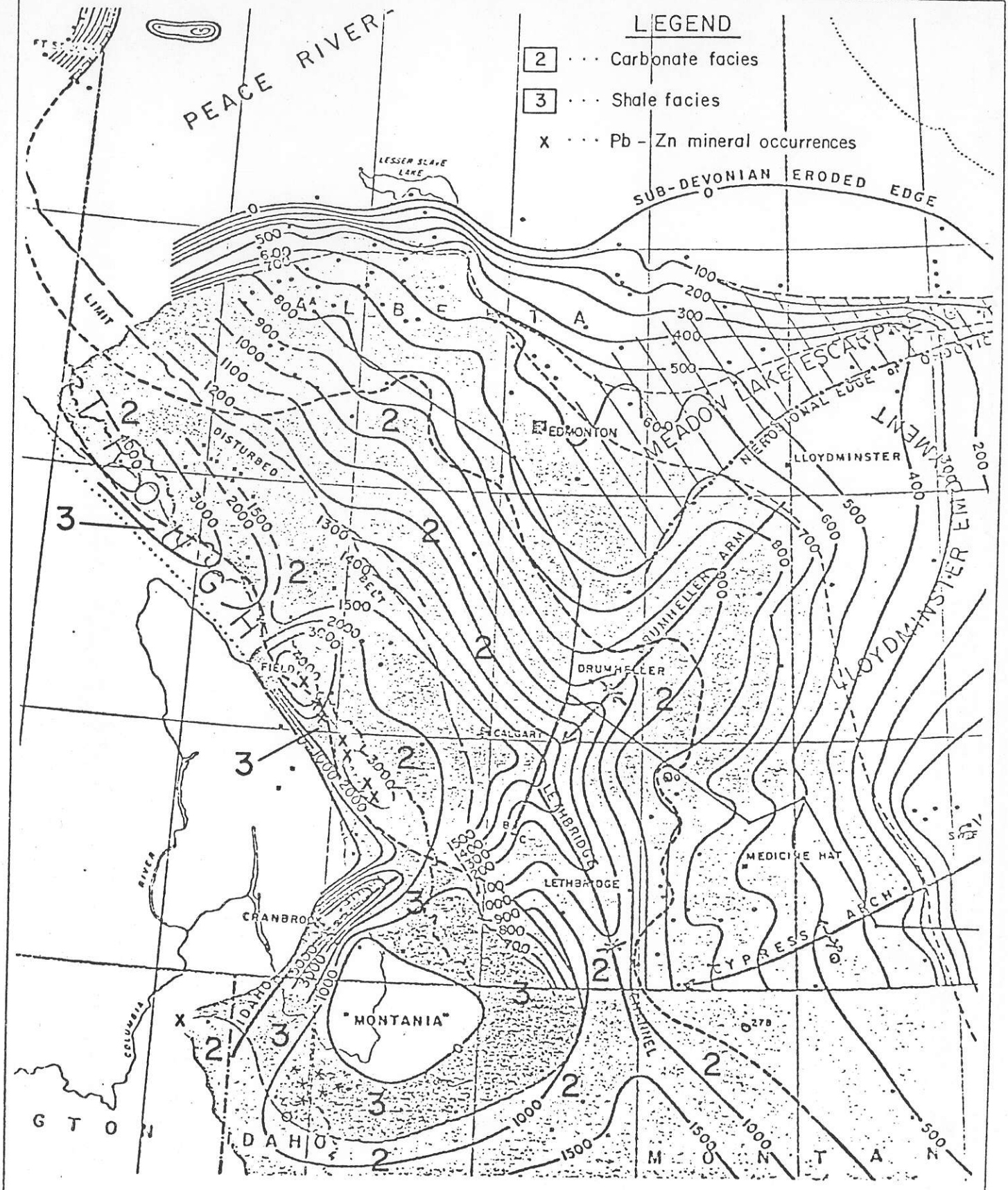


FIGURE 7 Middle Cambrian Lithofacies, Isopach, and Mineral Occurrence Map (after Van Hess, 1964)

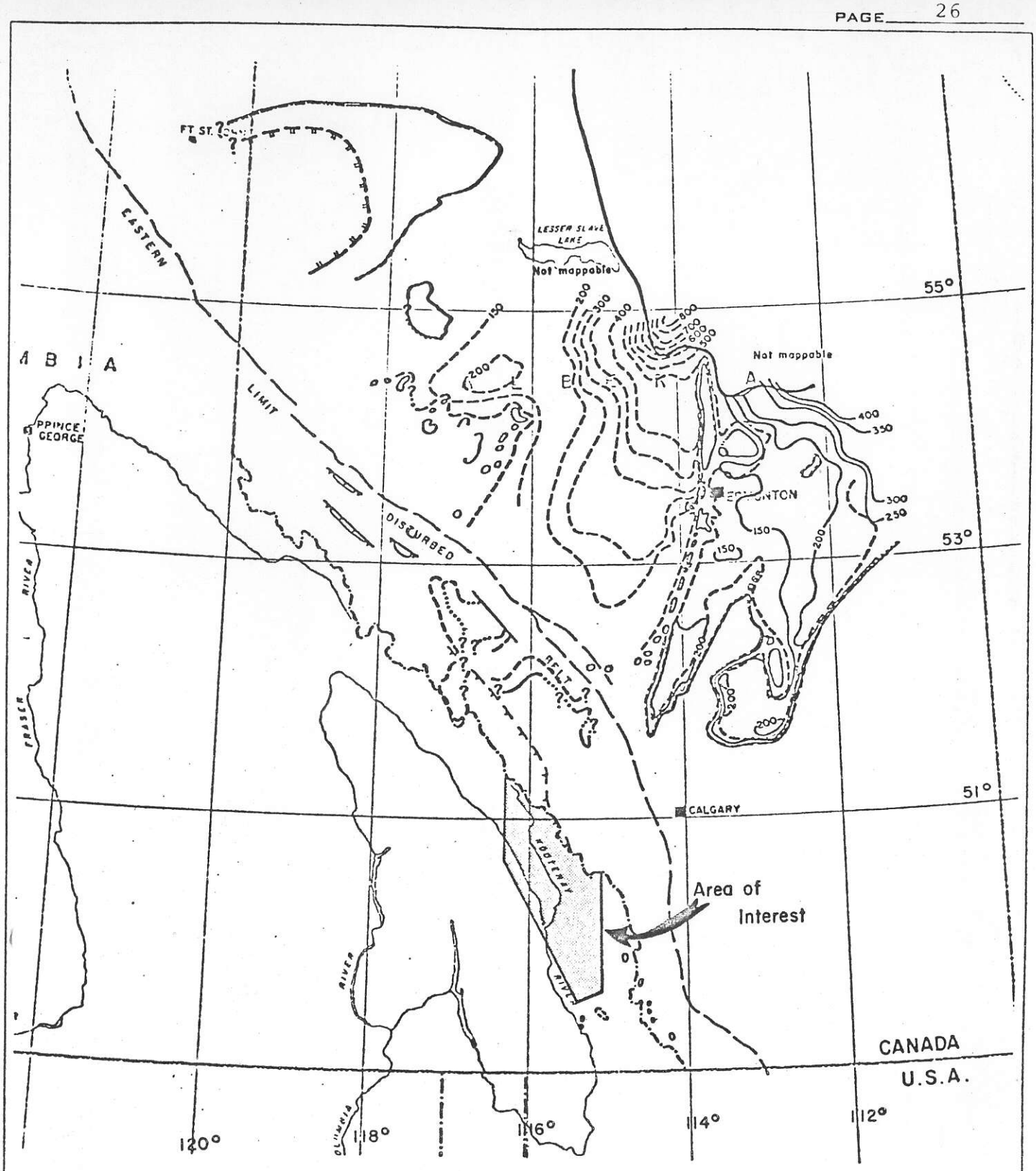


FIGURE 8 Upper Devonian Reefs and Carbonate Fronts in Southeastern B.C. and Central Alberta

Younger, Mesozoic rocks were probably deposited across most of the southern Rockies, but have now been eroded. Of those still preserved in the Elk and Flathead river areas, most are shales, coarse clastics, and beds of coal. Sedimentation was finally terminated in Early Jurassic time by the Laramide orogeny. Since then, there has been a significant amount of tensional block faulting, resulting in north-south-trending graben and half graben structures, such as the Rocky Mountain Trench, the Flathead Valley, and the Upper Kootenay Valley. As intrusive igneous rocks, there are a number of syenitic quartz monzonite plutons of Cretaceous age in the area, as well as numerous associated dioritic dikes. A field of kimberlitic diatremes presently of unknown age has recently been discovered, and at least one granitic intrusion of pre-Cambrian age is known.

7.3 Lower and Middle Cambrian Geology

7.3.1 Stratigraphy

The stratigraphic section (Table 2)shown below is representative of the lower and middle Cambrian rocks which outcrop extensively in Banff Park. Not all of these units are recognizable in the area investigated between Assiniboine Park and the Palliser River. (DWG G-8602-1).

7.3.2 Gog Group

This unit, the oldest of the Albert River map area, was easily recognized as it is the only quartzite found here in the entire Cambrian sequence. It was observed only along the lower reaches of Assiniboine and north

		EASTERN FACIES		WESTERN FACIES	
LOWER ORDOVICIAN	SURVEY PEAK FM. (Aitken & Norford, 1967)	Top not exposed; 800 feet; pale green shales with silty beds at base, limestone nodules toward top.		McKAY GRP. (Evans, 1933; Aitken & Norford, 1967)	Top not exposed; few hundred feet of greenish grey, soft, calcareous slates; at least one thick-bedded limestone unit.
UPPER CAMBRIAN	MISTAYA FM. (Greggs, 1962; Aitken & Greggs, 1967)	500 feet; thin-bedded, grey weathering limestone with brown weathering, dolomite partings.			
	BISON CREEK FM. (Greggs, 1962; Aitken & Greggs, 1967)	400 feet; brown and grey shale with rusty weathering limestone interbeds.			
	LYELL FM. (Walcott, 1920; Aitken & Greggs, 1967)	1000 feet; thick-bedded limestone and dolomite.		OTTERTAIL FM. (Allan, 1911)	1,500-2,000 feet; thick-bedded limestone. Beds are laminated grey and brown. 350 feet shale and dolomite at base.
	SULLIVAN FM. (Walcott, 1920; Aitken & Greggs, 1967)	U	300 feet; shale	CHANCELLOR FM (Allan, 1914) upper CHANCELLOR 3,300-4,500 feet	U slate
		M	700 feet; limestone and dolomite		M interbedded slate and limestone
		L	500 feet; shale with minor limestone, silty at base.		L Slate with silty beds at base
MIDDLE CAMBRIAN	WATERFOWL FM. (Greggs, 1962; Aitken & Greggs, 1967)	500-700 feet; thick-bedded dolomite, some limestone.		middle CHANCELLOR	about 2,000 feet; southern part: slates and orange-weathering dolomite at base, overlain by cleaved argillaceous limestone. Northern part: alternating 50-100 foot units of thin-bedded grey limestone and rusty slate.
	ARCTOMYS FM. (Walcott, 1920; Aitken & Greggs, 1967)	200-500 feet; varicoloured, shale, siltstone, and dolomite. Purple beds near base.			
	PIKA FM. (Deiss, 1939)	800 feet; limestone and dolomite, largely flaggy limestone with shaly partings.		lower CHANCELLOR	about 3,500 feet; irregularly interbedded grey, argillaceous limestone, brown and greenish brown shale, and thin-bedded brown argillaceous dolomite.
	ELDON FM. (Walcott, 1908; Rasetti, 1951; Aitken & Greggs, 1967)	1,200-1,500 feet; massive dolomite and limestone.			
	STEPHEN FM. (Walcott, 1908; Rasetti, 1951; Aitken & Greggs, 1967)	90-350 feet; greenish, siliceous, argillaceous shales, and thin-bedded limestone.			
	CATHEDRAL FM. (Walcott, 1908)	800-1,900 feet; massive dolomite and limestone.			
	MOUNT WHYTE FM. (Walcott, 1908; Deiss, 1939; Rasetti, 1951)	0-600 feet; alternating greenish silty shales and dark grey limestone; some sandstone.			
LOWER CAMBRIAN	GOG GRP. (Deiss, 1940; Okulitch, 1956; Mountjoy, 1962)	2,000-3,000 feet; thick-bedded, clean quartz sandstone with some shale interbeds. Up to 20 feet rusty limestone at top (Peyto limestone member)		GOG GRP.	not exposed
PRE-CAMBRIAN	MIETTE GRP. (Walcott, 1913; Mountjoy, 1962)	grey and brown slate; some pebble conglomerate; minor limestone.		MIETTE GRP.	not exposed

TABLE 2

Table of Cambrian Formations

(From Cook, 1970)

side of Aurora creeks, where it was composed of approximately 120 m (400 ft.) of massive bedded, pinkish and grey, well sorted resistant quartzites. The base was not exposed.

7.3.3 Mount Whyte Formation

This unit was also easily recognized, as a recessive thin-bedded, shaley unit lying conformably between massive Gog Group quartzites below, and massive resistant Cathedral Formation carbonates above. As with the Gog Group, it outcrops only along Assiniboine and Aurora valleys, but does extend to the head of Aurora Creek, and forms the base of both valley walls. Large blocks of Mt. Whyte shales occur as float along the Mitchell river, though here no outcrop was observed. Where observed, it is a sequence of well cleaved, non-carbonaceous greenish, thin bedded, buff weathering shales, approximately 90 m (300 ft.) thick. Intersections of two cleavage sets form conspicuous and characteristic diamond shaped patterns on weathered surfaces.

7.3.4 Cathedral Formation

North of Aurora creek, it is composed of approximately 370 m (1200 ft.) of massive dolomite, resting between the Mount Whyte Formation below, and a trilobite-bearing dark grey, rusty weathering, thin bedded siltstone unit above.

The Cathedral Formation definitely underlies the entire map area, while the southward continuity of the other formations is uncertain. The rocks mapped north of Mt. Brussilof, also definitely include the Stephen,

Eldon and Pika formations, while those mapped as Cathedral Formation further south may, in fact, consist of only that unit. In other words, the Stephen, Eldon and Pika Formations may be discontinuous to the south either because of non-deposition, a facies change to shales, or later Cambrian erosion. Almost certainly the Stephen and Pika Formations disappear south of Mt. Brussilof. If the Eldon continues southward, it is not distinguishable from the Cathedral Formation. Almost everywhere it outcrops, the formation has been intensely altered to coarsely crystalline magnesite and vuggy, recrystallized, dolomite zebra rock. Magnesite is most prevalent in the northern part of the target area, where it forms massive beds over 61 m (200 ft.) thick along the Mitchell River, Assiniboine Creek and the western slopes of Mt. Brussilof. Reserves here are many millions of tons of 90+% magnesite. Common accessories are well-formed pyrite crystals and patches of talc. Much coarsely crystalline material, either magnesite or dolomite, occurs pervasively along the Cross, Albert and Palliser Rivers. Bluish-gray, coarsely crystalline, vuggy, well banded zebra rock can be found almost anywhere the Cathedral Formation outcrops. Generally it is peripheral to the coarsely crystalline magnesite, and is probably a product of the same process which had not been taken to completion. Massive beds of non-vuggy, horizontally well-banded zebra rock, well over 30 m (100 ft.) thick, outcrop for at least 3.3 km (2 miles) along the lower reaches of Queen Mary Creek. Numerous unmineralized breccias, both chemical and mechanical,

that are likely the result of the same alteration process, have been found on the Shag claims, and along the Cross River and Queen Mary Creek. Only in the vicinity of the C-1 and C-3 showings were unaltered Cathedral Formation carbonate rocks found. It is the writer's opinion that the entire Cathedral Formation was intensely dolomitized, at some time after deposition and even after lithification, resulting in the formation of magnesite, zebra rock, coarsely crystalline dolomite, and both chemical and mechanical breccias.

South of Aurora creek the position of the upper boundary of the Cathedral Formation is uncertain, as the overlying trilobite-bearing shale unit becomes unrecognizable. As it was not possible to distinguish the Cathedral Formation from the similar but overlying Eldon Formation, without the intervening Stephen shale being present and visible, all three were mapped together as one unit.

Massive, cavernous, middle Cambrian carbonate beds up to 600 m (2000 ft.) thick, at least partly belonging to the Cathedral Formation, continue south across the Cross and Albert rivers, and finally disappear beneath upper Cambrian to Ordovician McKay Group shales on the south side of the Palliser River. These carbonates are bounded on the west by a facies front that runs down the Mitchell and Cross Rivers, through Millers Pass, and along the east side of the lower Albert River. The eastern outcrop limit of these massive carbonates is a blanket of overlying McKay Group shales that outcrop approximately along

a line extending from the head of the Cross river, to the mouth of Queen Mary Creek. The caverns reflect areas of intense recrystallization, to coarse magnesite or dolomite, that are now less resistant to weathering than the adjacent less altered rock.

7.3.5 Stephen Formation

This unit was tentatively recognized in cirques along the south side of Eon mountain, and in float along the upper part of Assiniboine Creek. It is composed of approximately 15 m (50 ft.) of thin bedded, recessive, blackish-grey coloured trilobite containing, rusty weathering siltstones. They break with a concoidal fracture. These beds were not recognized south of Aurora Creek and, if they exist, were mapped together with the Cathedral and Eldon Formations into one unit.

7.3.6 Eldon Formation

This formation is so lithologically similar to the Cathedral Formation, even in the extent of its alteration, especially to zebra rock, and recrystallized dolomite, that it was not possible to separate the two at the scale of the summer's work, except in places where the intervening Stephen shale is present. On Eon mountain, the Eldon consists of approximately 215 m (700 ft.) of massive bedded, recrystallized dolomite and zebra rock. It may not exist south of Assiniboine Creek.

7.3.7 Pika Formation

The boundary between this unit and the underlying Eldon formation was also not obvious, south of Eon Mountain

so it was mapped together with Cathedral, Stephen and Eldon formations, into one large unit. It is not believed to exist south of Assiniboine creek.

7.3.8 Arctomys Formation

This is an excellent, red coloured, marker horizon that defines the top of the single map unit that encompasses the Cathedral,and possibly Stephen,Eldon and Pika formations. It can easily be traced south from Mount Assiniboine, where it forms a prominent red band 305 m (1000 ft.) below the top of the mountain, to Millers Pass. It gradually thins and loses its colour southwards, so that if it exists south of Millers Pass, is not distinguishable from the overlying shales of the McKay Group. Where observed, it consists of less than 15 m (80 ft.) of purple and pinkish coloured, mudcracked shales. The shallow water and emergent oxidizing environment under which this unit formed, could also have caused the extreme alteration (dolomitization) of the underlying Cathedral Formation.

7.3.9 Chancellor Formation

The Chancellor Formation outcrops on the west side of a facies line that runs along the Mitchell, Cross and lower Albert Rivers, and contains lateral equivalents of all eastern middle Cambrian formations, Mount Whyte to Arctomys inclusive (DWG G-8602-1 and Table 2).Everywhere it is an interbedded sequence of shales and thin grey coloured limestones over 1000 m (3000 ft.) thick.

7.3.10 McKay Group

The McKay Group represents the western and southern shale facies equivalents, of a series of Upper Cambrian to lower Ordovician carbonate units, that outcrop in Banff Park, and as far south as Mt. Alcantara. It is lithologically similar to the underlying Chancellor Formation, and consists of between 185 m (600 ft.) and 1070 m (3500 ft.) of interbedded shales and thin limestones. These rocks are found on the tops of all mountains south of the head of the Cross river, and west of the Palliser, White and Bull rivers. They are particularly extensive on Mount Soderholm along the upper Albert river, and in the Royal Group. The carbonate facies equivalents form prominent cappings on the tops of all mountains from Mt. Alcantara, to at least as far north as Mt. Assiniboine.

7.3.11 Structural Geology

The area underlain by lower and middle Cambrian can be divided into four lithological parts, each having its own structural characteristics. These parts are underlain respectively by the massive carbonates, a narrow zone along the facies front, the shale facies, and the McKay Group.

The structure of the massive carbonates that lie east of the facies boundary is very simple. In a total sense, these rocks essentially form a flat-lying panel that regionally dips to the south and east at

approximately 18.9 m/km (100 feet/mi) , and is thought to be a thrust sheet. A few discontinuous but open folds were observed in the upper Albert, Cross and Alcantara valleys, and a series of north-south striking normal faults, all east side up, with displacements in the order of a few hundred feet, occur along the upper Albert river.

In contrast, the rocks along the facies boundary are extremely folded and faulted. Beds are locally overturned and minor thrust faults appear to be present. An anticlinal structure occurs all along this zone. The shale facies farther west also shows more pronounced folding than the carbonates, and contains a number of large, continuous, and steep sided anticlines and synclines. These rocks are also highly cleaved.

The McKay Group rocks, especially along the Upper Cross and Albert rivers, and in the Royal Group are highly deformed into a vast number of tightly compressed kinks and folds, and dip steeply to the southeast. Underlying massive carbonate units appear relatively undisturbed, though they may shale out, rather than continue for any distance underneath, and could be just as extremely folded.

The folding and high cleavage of the shale facies rocks resulted from their being pushed against the panel of massive, unyielding carbonates during the Laramide Orogeny. It is understandable that the most extreme

deformation was focussed in the facies-change zone along the leading edge of the carbonates.

7.4 Devonian Geology

The stratigraphic section shown below (Table 3) is taken from rocks in the extreme southern part of the project area, along the Bull river. Although the beds have not been adequately investigated, it is thought that this section can be applied, without much variation, anywhere along the belt, which runs at least 100 km (61 mi) north. Most of the Devonian rocks outcrop in a narrow belt that runs along the floors and east sides of the Palliser, White and Bull river valleys. They presumably once covered the entire southern Rockies, but have been eroded since the Laramide orogeny. Remnants are still preserved in a few synclines farther west and in a number of fault blocks which form a belt along the east side of the Rocky Mountain Trench between Radium and White Swan Lake. Most of the area between the remaining belts of Devonian rocks, is dominantly underlain by McKay Group shales and upper Ordovician to lower Silurian Beaverfoot Formation massive carbonates. Minor amounts of middle Ordovician shales and shelf quartzites are found locally.

7.4.1 Stratigraphy

The stratigraphic succession is shown in Table 3.

7.4.2 McKay Group

These rocks consist of thin-bedded shales and limestones of upper Cambrian to lower Ordovician age. They form a major part of the Rocky Mountains west of

Mississippian	Exshaw formation	Black shale; black limestone
Upper Devonian	Palliser formation	Lower (main) member: massive mottled grey limestone; nodular grey limestone. Upper member: thin bedded argillaceous limestone, mostly nodular
	Alexo formation	Sandstone and sandy limestone; argillaceous limestone
Upper Devonian (cont'd)	Fairholme group	Lower part: fine-grained black and grey limestone, stromatolitic and coralline in part; dolomite. Upper part: shale and limestone
Middle Devonian	Harrogate formation	Fine-grained, black limestone, shaly limestone; shale
Middle Devonian or earlier	Burnais formation	Gypsum, dolomite, limestone
Middle Devonian or earlier and(?) Upper Devonian	"Basal Devonian unit"	Dolomite, sandy dolomite, dolomitic sandstone, shale; quartzite, conglomerate
Unconformity		
Upper Ordovician Lower and (?) Middle Silurian	Beaverfoot-Brisco formation	Dolomite, limestone; conglomerate and sandstone locally at base, thin graptolitic shale near top
Disconformity?		
Middle or Upper Ordovician	Wonah formation	Quartzite, sandstone
Unconformity?		
Lower and(?) Middle Ordovician	Glenogle formation	Shale, siltstone, limestone
Upper Cambrian and Lower Ordovician	McKay group	Limestone, shale; intraformational limestone-conglomerate

TABLE 3: TABLE OF FORMATIONS
Upper Cambrian to Lower Mississippian

the Bull and White rivers, and thin northwards to approximately 600 m (2000 ft.) at the Palliser River. (DWGS G-8600-1, G-8601-1).

7.4.3 Beaverfoot Formation

The Ordovician to Silurian Beaverfoot Formation consists of up to 550 m (1800 ft.) of massive carbonate beds. It also occurs west of the Bull and White rivers, but outcrops much less extensively than the McKay rocks. It rests unconformably on McKay Group rocks throughout most of its outcrop area. Locally middle Ordovician shales and quartzites intervene, and are also unconformably overlain by Beaverfoot carbonates.

7.4.4 Basal Devonian Unit

At the base of every complete section of Devonian rocks examined, there occurred a section of reddish siltstones, quartzites and conglomerates less than 90 m (300 ft.) thick known as the basal Devonian unit. The dominant rock type is quartzites, but feldspathic conglomerates, silty dolomites and shales are common, with volcanics (basalt?) occurring locally. The main characteristic of this unit is its rusty or reddish colour, that occurs everywhere, despite the wide variation in lithologies.At the base of this unit there is a very important break, that is well known throughout the entire Rocky Mountains as the sub-Devonian unconformity. The basal Devonian unit lies on the Ordovician-Silurian Beaverfoot Formation everywhere north of Quinn Creek, but the unconformity cuts rapidly downward to the south, so that only 33 km (20 mi) distant, at the mouth of Iron Creek, the same Devonian beds rest on Pre-Cambrian rocks. All of the Devonian rocks investigated during the exploration programme, were mapped as one single unit. (DWG. G-8603)

7.4.5 Burnais Formation

This group of middle Devonian rocks consists of varying thicknesses of dolomite, limestone and gypsum beds. In the Lussier valley their total thickness is approximately 214 m (700 ft). Gypsum is very widespread within the formation and occurs in almost every outcrop. Where it is absent a strange, streaky appearing breccia is found, that may have formed as the gypsum beds were dissolved. The gypsum thins dramatically southeastward from the Windermere area, where it is over 300 m (1000 ft.) thick, to the upper White and Bull river areas, where it is less than 30 m (100 ft.) thick. Gypsum outcrops are rare, however its presence can usually be inferred from sink holes, travertine and the presence of Recent conglomerates that are cemented Pleistocene gravels. Ground water has derived the cement by leaching gypsum beds, and then precipitated it in porous gravels downslope, to form a very resistant conglomerate.

7.4.6 Harrogate Formation

This formation generally consists of thin interbedded limestones and shales up to 300 m (1000 ft.) thick. In the upper Bull river valley, the limestones become in part dolomitic and quite massive, and shales are uncommon. A recrystallized dolomitic breccia unit with interstitial sphalerite, occurs as a bed south of Munroe Lake. On strike, approximately 7 miles north, a similar dolomitic breccia unit outcrops, and has a thickness of over a hundred metres. Here it contains some interstitial

fluorite but no sphalerite. If both of these occurrences are part of the same bed, then this breccia unit is an important constituent of the Harrogate Formation. Fossils collected by government geologists show that the Harrogate Formation can be correlated in age with the Pine Point Formation, a back-reef facies of the Presquile Reef (Figure 9). Both are late middle Devonian in age.

7.4.7 Fairholme Group and Alexo Formation

These upper Devonian rocks were not investigated in any detail, so only a little can be said about them. Where observed, they are a sequence of highly fossiliferous, light grey, coarse grained, massive-appearing limestones with minor blackish shales. They occur only along the east side of the Palliser, White and Bull valleys in a narrow band approximately 210 m (700 ft.) thick. Their regional outcrop pattern is shown on figure 10, taken from Zeigler, 1969. The location of reefs and regional reef-trends are shown in figure 8.

7.4.8 Palliser Formation

These rocks also were not investigated thoroughly and so very little can be discussed here. They outcrop quite extensively along the east side of the White river, particularly in the vicinity of Maiyuk creek, where they form the crest of a broad anticline. They appear as a massive cliff-forming set of limestone beds well over 300 m (1000 ft.) thick in the belt along the Palliser, White and Bull valleys. Their age is upper Devonian, and their regional distribution and facies boundaries are shown on figure 10.

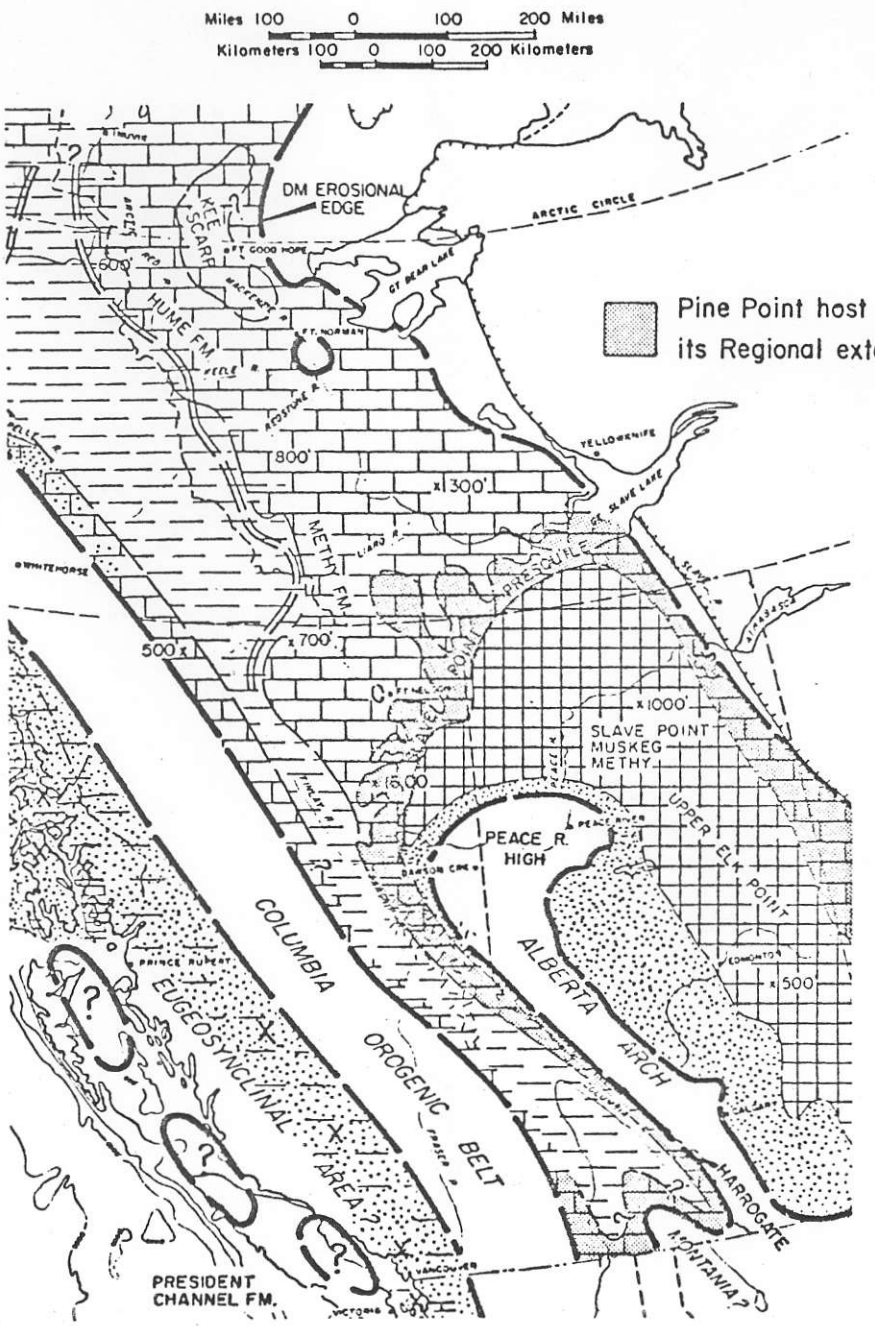


FIGURE 9 Correlation of the Mineralized Presqu'ile Reefs with the Harrogate Formation.

(After Zeigler, 1969)

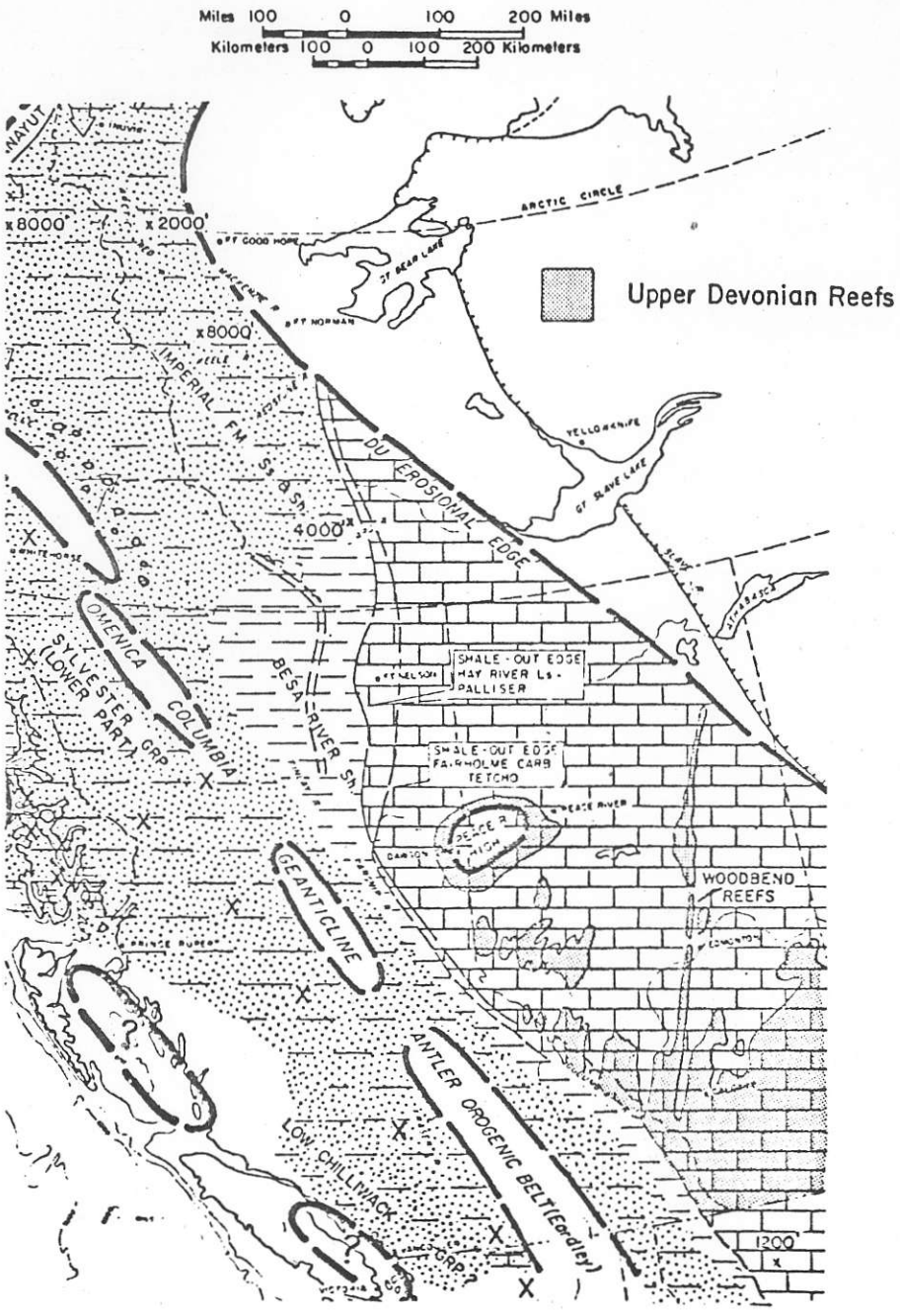


FIGURE 10 Upper Devonion Facies Map Showing Locations of Reefs.

(After Zeigler, 1969)

7.4.9 Exshaw Formation

The Exshaw Formation disconformably overlies the Palliser Formation, and oontains the Devonian-Mississippian boundary. It only outcrops along the extreme eastern side of the Palliser, White and Bull river valleys, and does not exceed 20 m (70 ft.) in thickness.

7.4.10 Structural Geology

The area contains a number of major anticlines, synclines and thrust faults, none of which were traced very far along strike, but are very continuous. Major synclines, containing remnant middle Devonian strata, lie along the upper Lussier and Quinn creeks respectively. One major anticline was traced down the east side of the Palliser and White valleys as far south as Maiyuk creek. A major thrust fault,with the hanging wall drag folded into a large syncline, occurs along the east side of Bull valley near Munroe Lake. It likely extends north to the head of the White River and south to the mouth of Quinn Creek. McKay strata, which cover most of the area, are severly deformed into narrow, tight folds and kinks.

8. MINERALIZATION

8.1 Pb-Zn Occurrences Within Cambrian Rocks

8.1.1 Monarch - Kicking Horse Mines

A very good discussion of these orebodies has been presented in an Alberta Society of Petroleum Geologists Guidebook (Ney, 1954). These two mines occur on strike with each other, on opposite sides of the Kicking Horse valley, about 1200 m (4000 ft.) apart (Figure 11). The orebodies each extend back from their valley walls for approximately 750 m (2500 ft.). It appears that the mines are actually the northern and southern remaining extensions of a once much larger ore field, that was at least 2750 m (9000 ft.) long (Figure 12). Total production from these deposits was 850,000 tons grading 7% lead, 10% zinc, 1.2 oz. silver per ton, with a minor amount of copper.

The general shape of the numerous associated orebodies is that of flattened cigars, with vertical cross sections varying from 1.8 m (6 ft.) by 6 m (20 ft.) to 7.5 m (25 ft.) by 12.0 m (40 ft.) and horizontal lengths up to 732 m (2400 ft). The orebodies occur in thin envelopes of dolomite, within otherwise typically thick sections of Cathedral Formation limestones, and this zone of dolomite alteration accompanies all of the orebodies for their entire lengths, often transecting bedding. (Figure 13 and 14). All productive orebodies were found in the lower 120 m (400 ft.) of the Cathedral Formation

approximately 0.8 km(0.5 mi) east of the middle Cambrian facies boundary.

8.1.2 Hawk Creek or Albion Deposit

The geology of this deposit was described in the Department of Mines Annual Report for 1953 (Henderson, 1953). The deposit occurs in limestone of the Chancellor Formation, approximately 3.3 km (2 mi) west of the middle Cambrian facies boundary. The ore zone is an irregular, cigar-shaped body about 17 m (55 ft.) wide, and a maximum of 5.5 m (18 ft.) high, that has been explored only for 75 m (250 ft.) along strike (Figure 15). Most of the ore zone is massive fine-grained sphalerite which forms 1 mm thick bands along the contact with the host limestone. Much of the massive sphalerite itself contains many short pieces of bent and folded,1 mm thick bands of fine grained sphalerite that appear to have formed during a phase of soft-sediment deformation, and as rip up clasts. Grades of 46% zinc, 0.45% lead and 2.1 oz. silver per ton, across a widths of 1.8 m (6 ft.) are common (Figure 15). An estimate of 29,500 tons of ore grading 12.5% zinc, with a little lead and silver, but no copper, has been given for the deposit, which still remains largely unexplored.

8.1.3 Eldon Deposit

This occurrence has been very briefly described in a M.Sc. thesis (Evans, 1965). It consists of a zone several hundred feet long, that contains sphalerite, galena, chalcopyrite and minor pyrite in a gangue of quartz and siderite. Minor amounts of sericite occur intimately associated with the sulphide minerals. No values or estimates of the grades were given, and silver was not mentioned. The host units are lower to middle

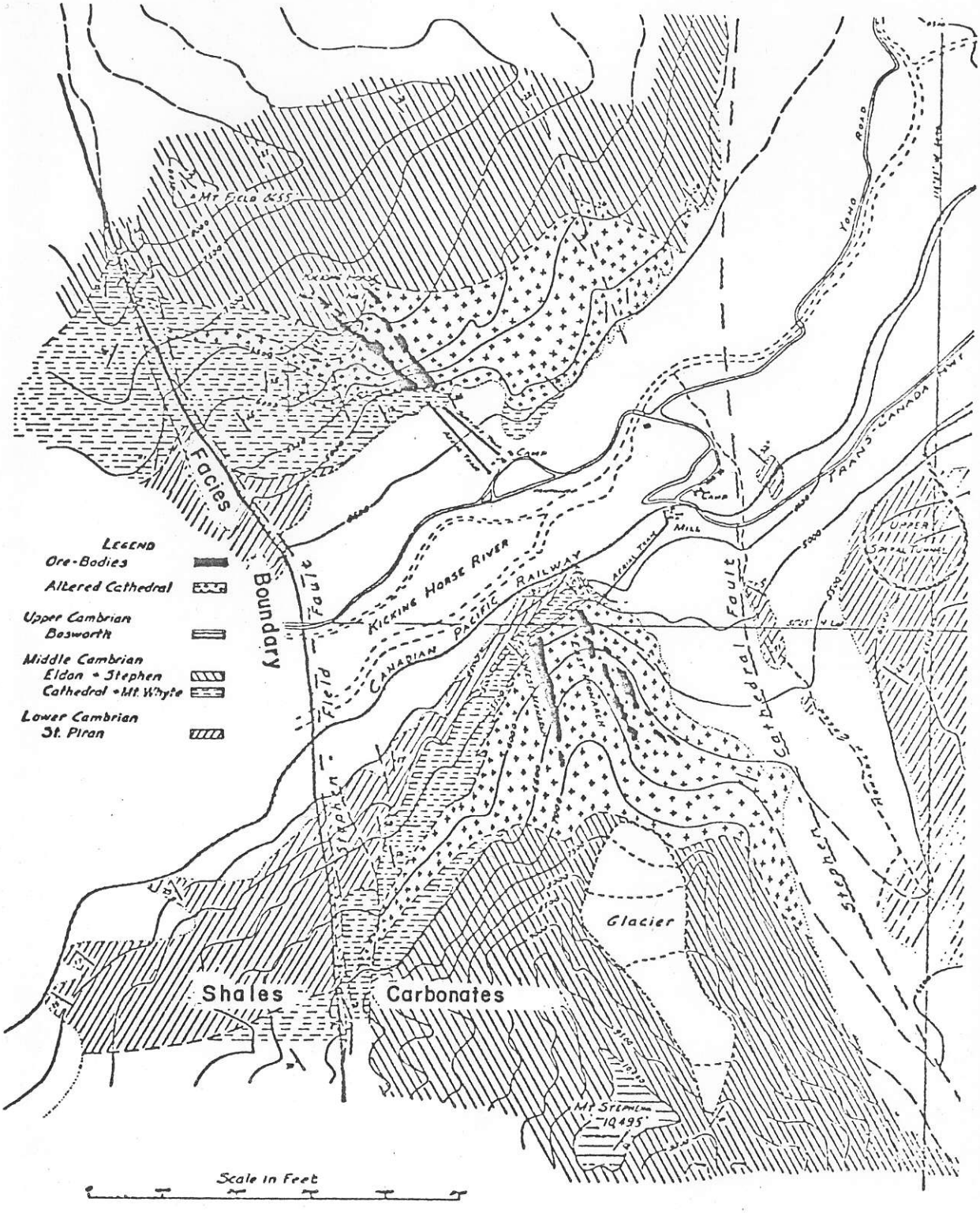


FIGURE 11 MONARCH AND KICKING HORSE MINES

GENERAL GEOLOGY

(Taken from Ney 1954)

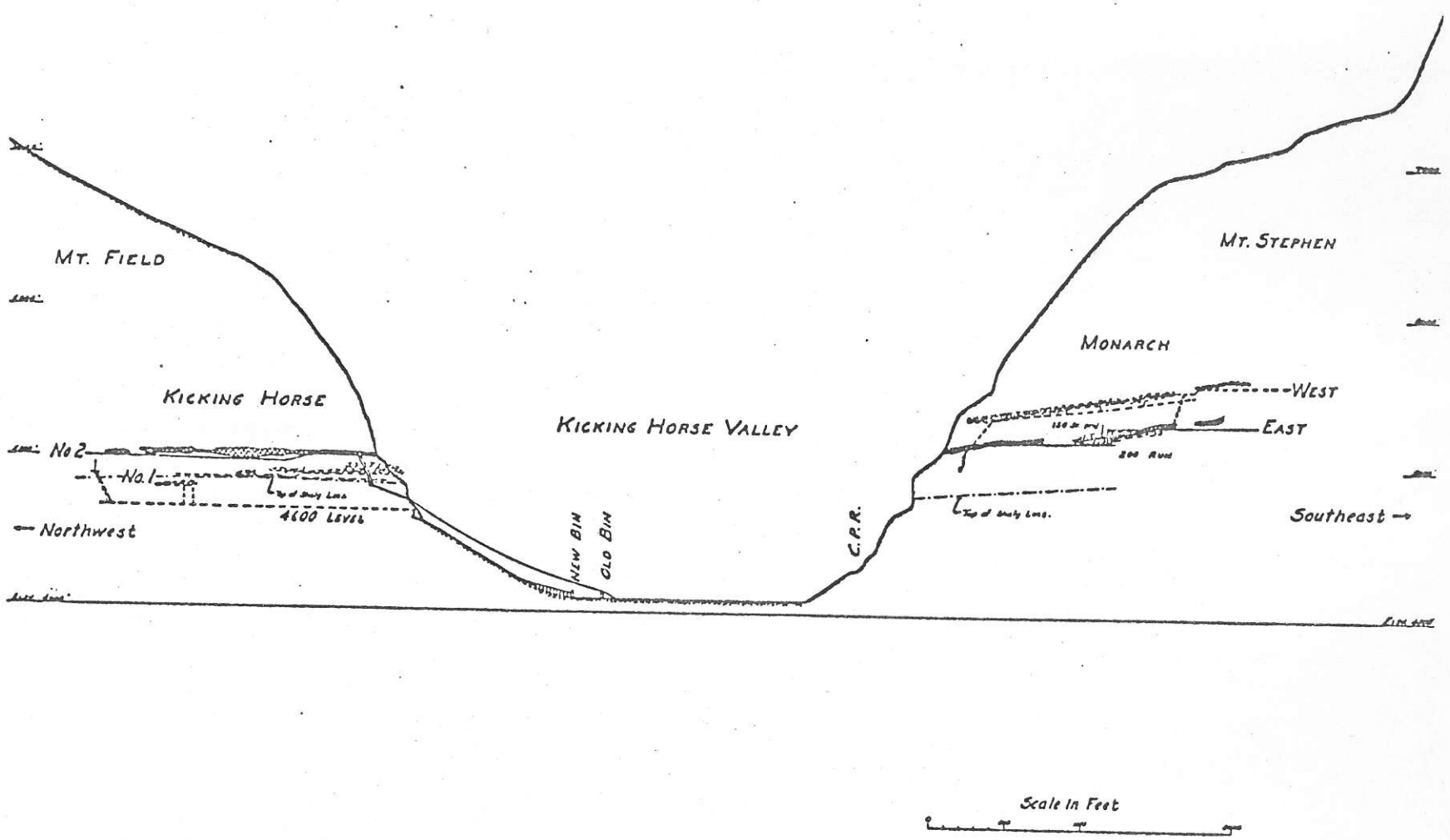


FIGURE 12 MONARCH AND KICKING HORSE MINES
LONGITUDINAL PROFILE
(Taken from Ney 1954)

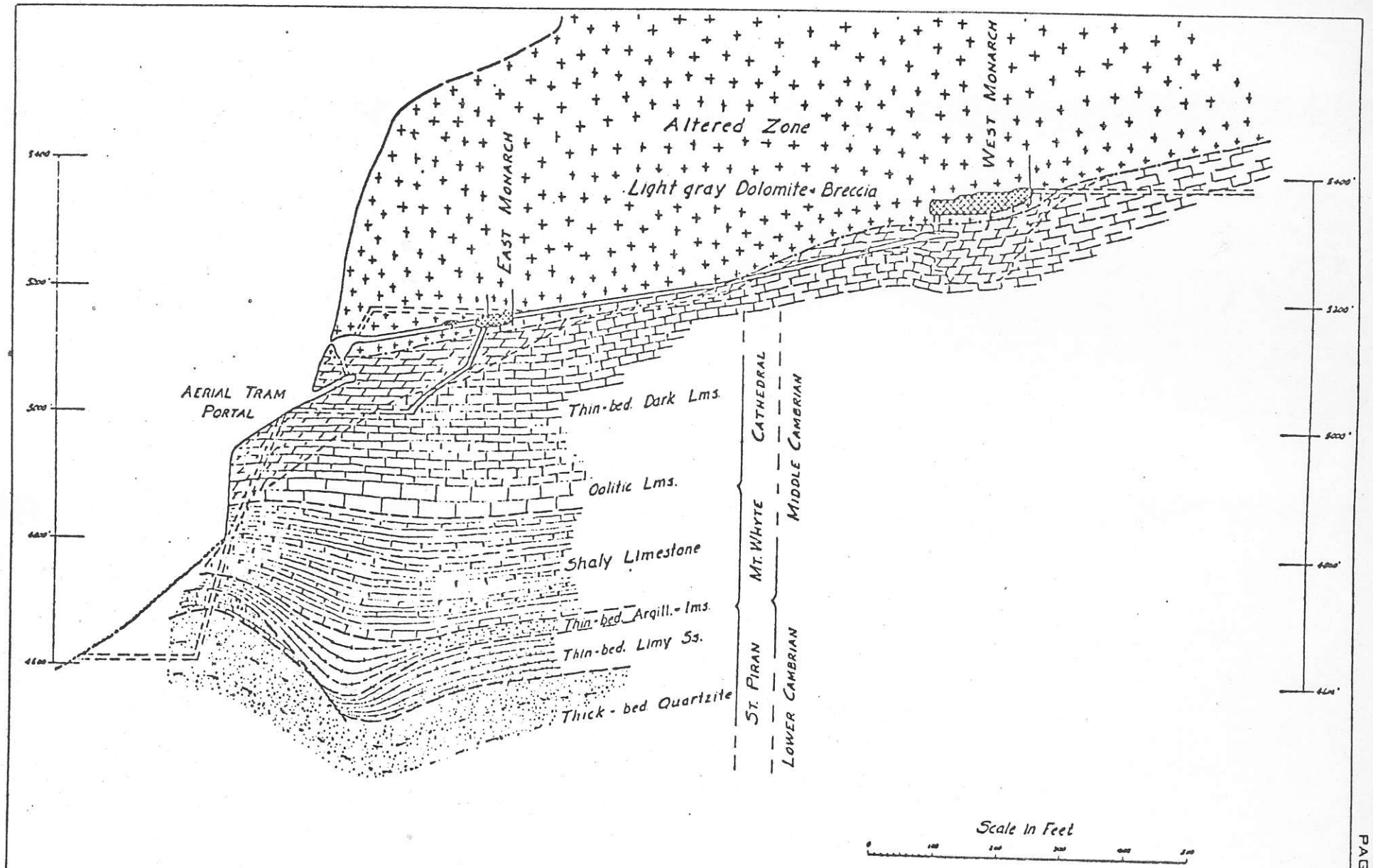


FIGURE 13 CROSSECTION OF MONARCH MINE OREBODIES

SECTION 'A'

(Taken from Ney 1954)

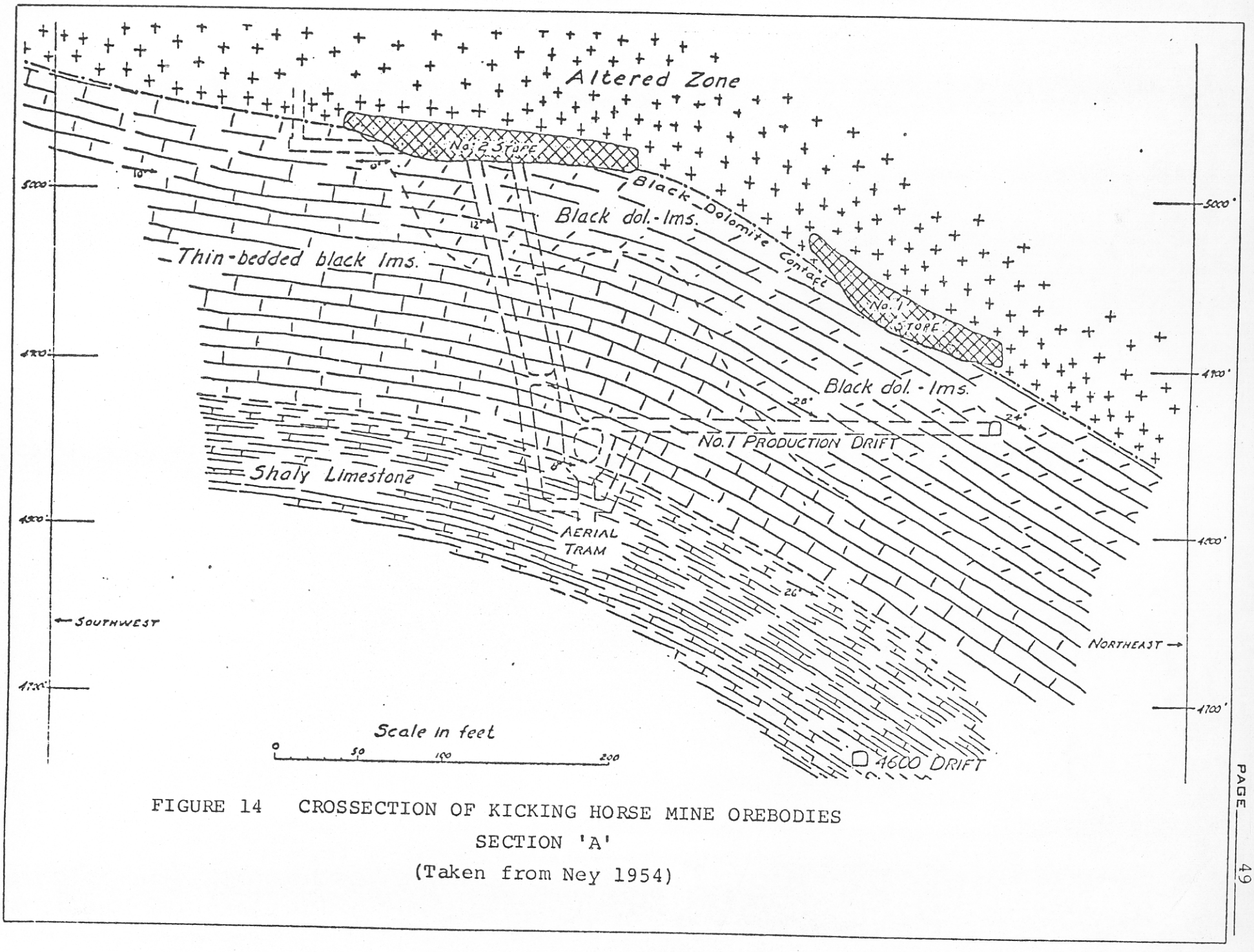


FIGURE 14 CROSSECTION OF KICKING HORSE MINE OREBODIES

SECTION 'A'

(Taken from Ney 1954)

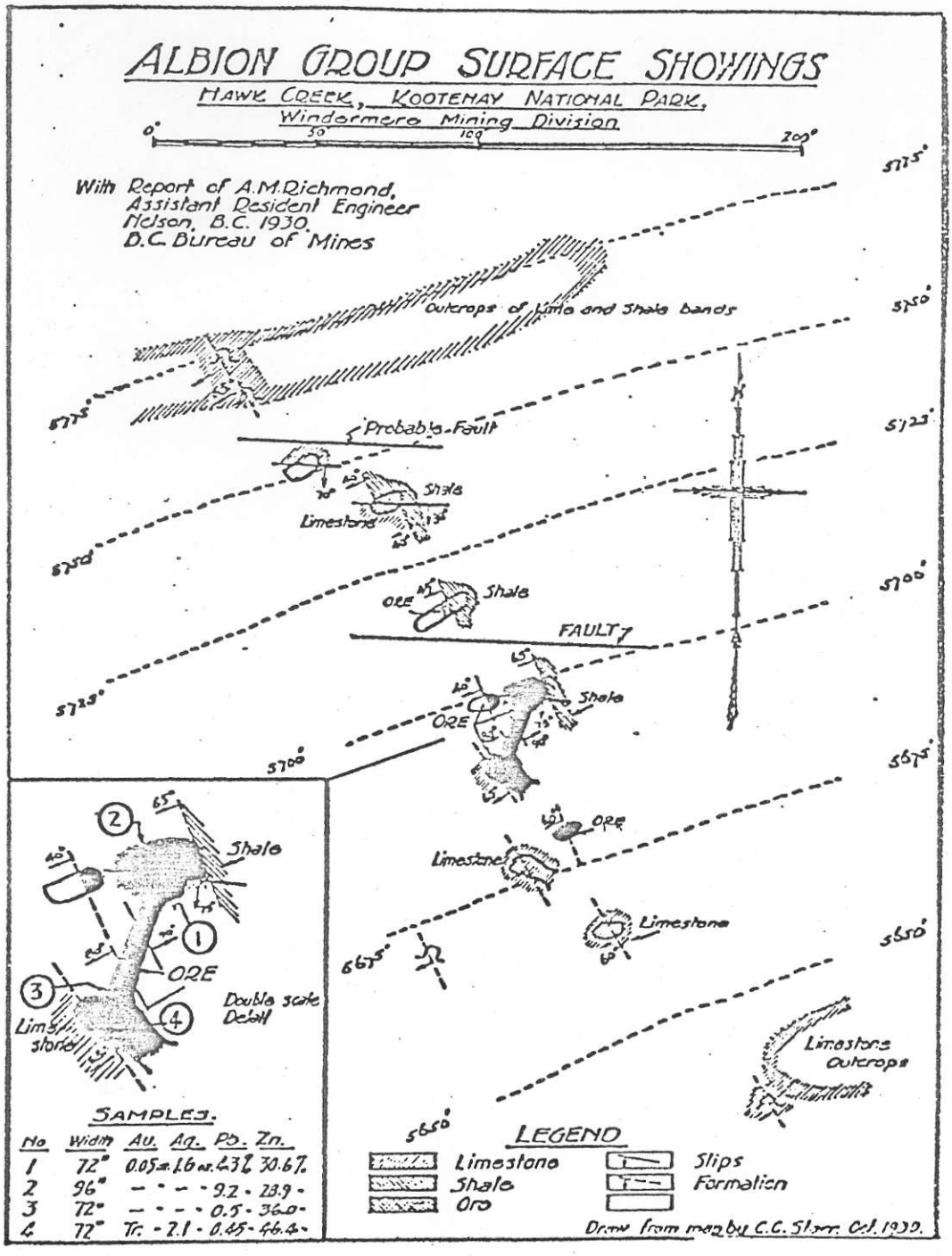


FIGURE 15 ALBION GROUP SURFACE SHOWINGS

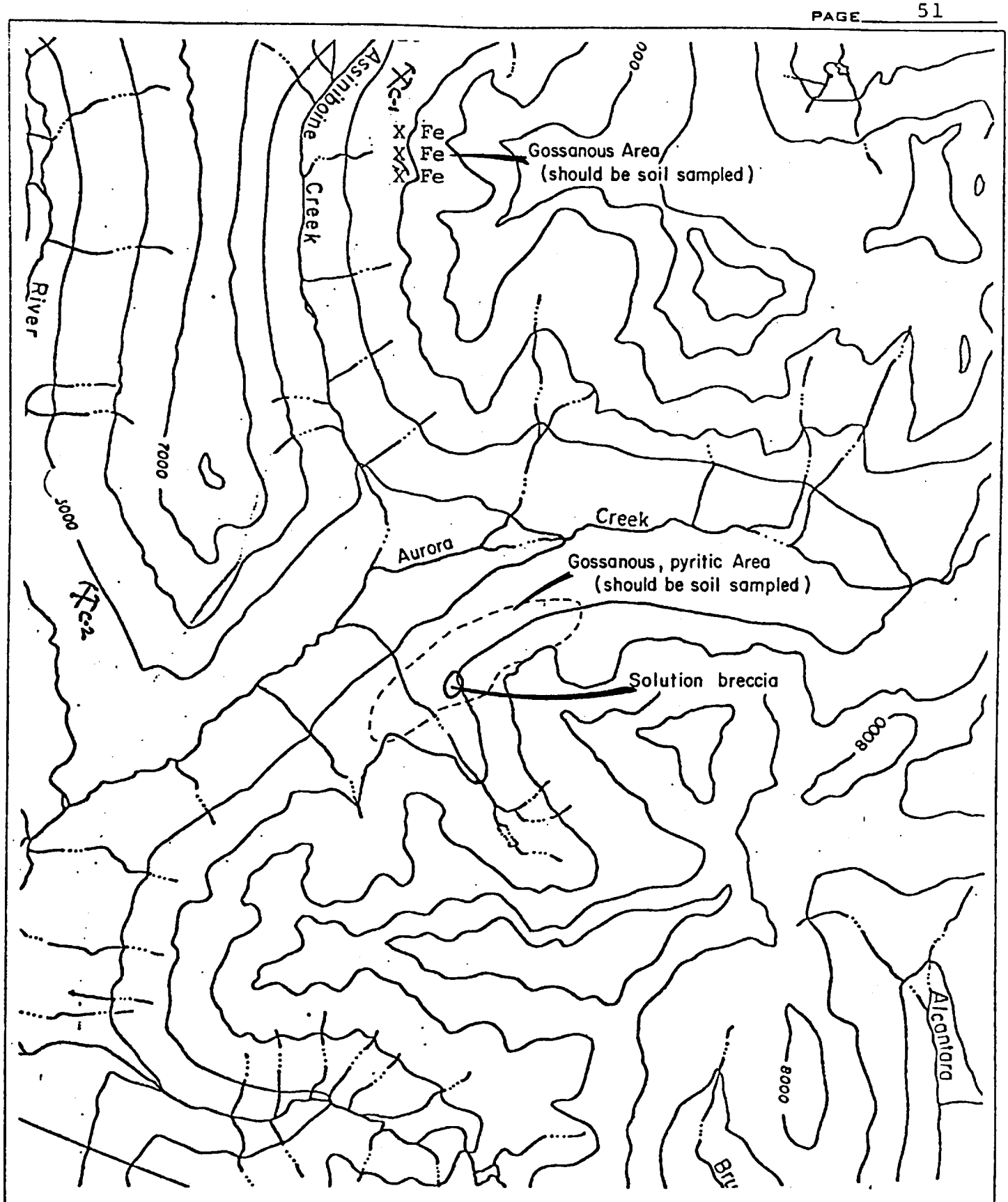


FIGURE 16 Location of Gossanous Area

Cambrian, brown, calcareous and argillaceous rocks, and the deposit appears to be a quartz vein stockwork, rather than Mississippi Valley-type.

8.1.4 Baker Creek Deposit

The only description of this deposit is also by Evans in 1965. The showing occurs in black dolomite veined with white crystalline, coarse, grained dolomite. The host rocks are middle Cambrian in age and likely belong to the Cathedral Formation. The dolomitic rocks in the vicinity of the Baker Creek claims closely resemble those found associated with the Monarch-Kicking Horse Mines. The only sulphide mineral observed by Evans was galena, and no grades, or indications of the size of the deposit were given.

8.1.5 Paint Pots Heavy Mineral Springs and Ochre Field

This occurrence does not contain any lead or zinc sulphides, and is included here only because it is believed by the writer to be the surface expression of an orebody at depth nearby. The area covered by active and extinct springs, as well as the iron oxide deposits (ochre fields) that they have formed, is at least 2 ha (5 acres). The limonite deposits are, in places, well over 6.1 m (20 ft.) thick, and are at least 2 m (6 ft.) thick over the entire 2 ha (5 acres) that they cover.

The area was mined in the early days for its ochre deposits, which were used at that time as a paint base. Presently, they are in a National Park, and only a passing curiousity for tourists. A recent geochemical study made on the occurrence, showed that both the spring waters and their iron oxide precipitates were very strongly

anomalous in lead and zinc. (Van Everdingen, 1970).

The area is located less than 0.4 km (0.25 mi) to the shale side of the middle Cambrian facies boundary, between the Monarch mine, 30 km (18 mi) north, and the Hawk Creek deposit 10 km (6 mi) south. Owing to its location along the facies boundary, between two large facies associated deposits, and the fact that an extensive deposit of iron with associated lead and zinc has been precipitated, leads the writer to believe that a significant Mississippi Valley type orebody exists here at depth, or up-slope.

8.1.6 C-3 Showing, Shag Claim

This is a new occurrence which was found by prospecting in 1977. It is located within Cathedral Formation carbonates, on the south side of the Albert River, across from the mouth of the creek draining Millers Pass (Figure 3). The mineralization occurs at the base of a very steep cliff over 275 m (900 ft.) high, below which a long talus slope extends another 214 m (700 ft.) to the Albert River. Most of the mineralization was found in the talus, as most of the cliff face was too steep to prospect. A mineralized zone was observed however, in outcrop at the base of the cliff. It consists of a series of vertical solution tubes containing reddish-orange sphalerite, each approximately 15 cm (6 in) wide, and spaced at approximately 1 m (3 ft.) intervals across a total width of 9 m (30 ft.) The average grade in these narrow mineralized solution zones would be about 5% zinc, with no lead. The rock between these zones is unaffected

by solution and barren of sulphides. A number of mineralized grab samples were collected from the talus, and gave assays ranging from 5% zinc to 27% zinc, with an average value of 10% and no lead (Appendix I). Black, reddish-orange and honey-coloured sphalerites are found in samples collected from the talus, but only the reddish-orange variety has been located in place on the cliff. Samples containing the other varieties of sphalerite generally have higher zinc values, as the brecciation and mineralization is usually much stronger. Most of the mineralization is fracture filling, but sphalerite rims breccia fragments up to 2.5 cm (1 in) across. White sparry dolomite also commonly occurs with the sphalerite, filling fractures and cementing small breccia fragments. Many of these breccia fragments have been strongly replaced by pyrite, which is only visible when the specimens are highly polished.

Approximately 60 m (200 ft.) west, at the same elevation, a set of similar,but pyrite containing,vertical solution features occur, over a width of 9 m (30 ft.). No sphalerite was observed, but may occur in small amounts and assays are necessary. Also, a one metre-wide rusty streak was observed to run down a cliff face and onto the talus below, in one place, approximately 150 m (500 ft.) east and 60 m (200 ft.) above the zone of observed sphalerite mineralization. This location was only observed from a helicopter, and no surface prospecting has been done on it.

In the vicinity of the sphalerite mineralization the host rock is a dolomite, while only 30 m (100 ft.) west it is a limestone. This showing occurs less than 350 m

(1000 ft.) on the carbonate side of the middle Cambrian facies boundary and has typical Mississippi Valley type characteristics.

8.1.7 C-4 Showing, Shag Claim

This also is a new showing that was found by prospecting in 1977. It occurs in the bottom of the first creek flowing north into the Albert River east of the C-3 showing, approximately 5 km (3 mi) upstream from its mouth (Figure 3 and DWG. G-8603). The mineralization occurs on both sides of the creek across a distance of about 8.0 m (25 ft.) and extends upstream for at least 10 m (30 ft.). Mineralization was observed across a maximum stratigraphic thickness of 1.2 m (4 ft.) but is concentrated mainly in a much narrower zone about 0.3 m (1 ft.) thick. Sphalerite is the most common sulphide with both reddish and honey-coloured varieties occuring, and lesser amounts of galena and pyrite are usually present. Assay values varying between 4% to 20% zinc, and 0.45% to 9% lead have been obtained from grab samples (Appendix I). A zone approximately 0.3 m (1 ft.) thick that contains at least 50% sphalerite and a few percent galena, occurs on the west side of the creek. This zone is horizontal and conformable to bedding. Much of the mineralization appears to be replacement rather than open space filling, and only minor amounts of white sparry dolomite were observed. Outcrop is limited to the creek bed, making it difficult to fully evaluate the showing, but clearly more work is necessary. The host rock is limestone of the Cathedral Formation, and the showing lies approximately one mile to the east of the middle Cambrian facies boundary.

8.1.8 C-1 Showing

This is a new showing found in 1977, that occurs on the east side of Assiniboine Creek approximately 0.4 km (¼ mi) south of Lunette Lake (Figure 2, Figure 16 and DWG-G-8603). The mineralization occurs in a dolomitized crackle breccia near the top of the Cathedral Formation. The breccia zone is approximately 4.6 m (15 ft.) thick, and extends for over 180 m (600 ft.) along strike, and possibly much further. It consists of a dark blackish coloured, recrystallized, rusty weathering silty dolomite that contains numerous fracture fillings and patches of white sparry dolomite up to 2.5 cm (1 in) across. Rarely these fracture fillings contain disseminated sphalerite and galena, and assays of grab samples gave average values of 0.5% zinc and 0.1% lead (Appendix I). The sphalerite is almost never seen in hand specimens as the rocks are strongly oxidized, especially along fractures. The rusty surfaces always react slightly positively when the zinc indicator is sprayed on them, but contain no sphalerite inside, showing that there is a lot of down-slope chemical transportation of zinc here. Numerous goethite-limonite clinkers, up to 0.3 m (1 ft.) across, occur all along this breccia zone, indicating the presence of a considerable amount of iron. They also occur intermittently for about 1.6 km (1 mi) along strike to the south, where a soil sample gave anomalously high lead and zinc values. It is therefore believed by the writer that the C-1 mineralized zone extends for at least 1.6 km (1 mi) along strike. It is not known if the grade increases to significant values any where along the zone. This showing has many typical Mississippi Valley type characteristics.

8.1.9 C-2 Showing

This showing was found by prospecting in 1977 as well, and consists of numerous hydrozincite coated rocks and boulders that are scattered along a road cut over a distance of about 30 m (100 ft.) (Figure 2). Along this short section of the road, hydrozincite coats about 5% of the boulders. They occur in a deposit of unconsolidated gravel,sand and boulders that could either have formed as glacial drift or as a stream or snow-slide deposit. No where else along the road for distances over 0.8 km (½ mi) on either side of the C-2 showing, do any hydrozincite-coated boulders occur. At the C-2 showing sphalerite has been found in minor amounts in a number of pieces of blackish, brecciated dolomite. These are by far the most common type of mineralized rock that occurs. One large 9 kg (20 lb) rock was found, that contained 5 cm (2 in) long breccia fragments of many lithologies, cemented by a matrix of fine-grained non-sparry dolomite, and fine grained sphalerite and pyrite. The type of breccia and mineralization resembles that of a trash zone in a karst cavern. As well, two fist sized pieces of solid galena and sphalerite were found on the road 15 m (50 ft.) away. Although the gravel in which the boulders occur appears to be glacial drift, the writer believes, on the basis of the large number of mineralized boulders in this section as opposed to the rest of the road, and the fact that there are three different types of mineralization present, that the source is local and possibly upslope 30 m (100 ft.) or so. Soil samples taken from the road cut, and also from a point 6 m (20 ft.) above the cut in a valley, gave anomalously high lead and zinc values, showing that the metal enrichment here

is quite pervasive. It is of particular interest that these soil samples are highly anomalous in lead, as only two pieces of float in the road cut were found to contain galena. The large mineralized breccia boulder has come from a significantly mineralized zone, as indicated by the type of breccia, and the extent and mode of its mineralization. The occurrence of botryoidal sphalerite and marcasite in the one fist-sized sulphide cobble adds to the showing's potential. The writer believes that all the mineralized pieces at the C-2 showing originated from the same place, and that further efforts should be made to locate the source.

8.2 Occurrences in Devonian Rocks

8.2.1 Deep Purple and Candy Claims

This is a new showing that was discovered at the head of Rock Canyon Creek in 1977 (Figure 4). The entire valley has been burned by forest fire, and subsequent bulldozer roads traverse all the hillsides and many side valleys. Numerous boulders of purple and white fluorite, some larger than 0.3 m (1 ft.) across were found scattered along one bulldozer road, over a distance of approximately 60 m (200 ft.). They were traced upslope from the bulldozer road for a distance of 90 m (300 ft.) but no outcrop was found. Assay values from 5 grab samples gave results as high as 32% fluorine and 7.7% barium, with much lesser amounts of strontium and lead (Appendix 1). Similar boulders have been found sparsely scattered in other bulldozer roads up to 0.4 km (¼ mi) away, and probably come from separate sources because of their random locations with respect to each other. Numerous small pieces of rusty oxidized float, containing minor purple fluorite,occur along many bulldozer roads, and in one

place were traced to outcrop. There is a lot of fine-grained pyrite in these rocks, and many hillsides are rusty coloured because of iron oxides in the soil. Often the pyrite is associated with fluorite so the potential area of fluorite mineralization is also quite widespread. Some samples are slightly radioactive(2 - 3 times background) and upon assay a single sample was found to contain minor amounts of rare earths, thorium and potassium, but no uranium.

The writer believes the mineralization to be a stratifrom deposit in the middle Devonian Burnais (gypsum) Formation. On the fluorite claims, a strange brecciated bed over 6.1 m (20 ft.) thick, containing fine grained fluorite and barite is thought by the writer to take the place of the usually present gypsum beds, although the presence of at least minor amounts of gypsum is inferred from the occurrence of a recent conglomerate in one creek bottom.

8.2.2 Bull River Fluorite

This occurrence of fluorite was discovered by the writer two years ago, and is only mentioned here to show similarities to the Deep Purple claim and give evidence that both are stratiform deposits (DWG G-8603).

This fluorite also is purple, very fine grained, associated with barite and slightly radioactive. It occurs at the same stratigraphic horizon within the Devonian succession, in an identical strange breccia unit to that found at the Deep Purple claim, however the two

showings are at least 42 km (25 mi) apart. At Bull River the breccia unit appears to take the place of the gypsum beds, as it also does in the Deep Purple area. These similarities raise possibilities that the 42 km (25 mi) long belt in between may contain more and perhaps even better fluorite deposits than those already found.

8.2.3 Munroe Showing

This is a showing found by Silver Standard Mines Ltd. in 1972 (DWG. G-8603). They have done a limited amount of drilling in a probable recrystallized dolomite breccia within the middle or upper part of the middle Devonian Harrogate Formation. The dolomite breccia? unit is at least 6.0 m (20 ft.) thick on the property and contains numerous irregular blobs and wisps of white sparry dolomite generally about 1.5 cm (½ in) across, in a matrix of subhedral to euhedral grains of dolomite approximately 1 mm across. Subhedral to euhedral disseminated grains of light yellow coloured sphalerite occur within the dolomite matrix in places. Grades are not high, and a chip sample across 2.1 m (7 ft.) gave an assay of less than 2% zinc, although grab samples containing over 10% zinc can be found (Appendix I). No galena or pyrite exists but a minor amount of purple fluorite has been observed. Mineralization is patchy but continuous along a 92 m (300 ft.) long trench, and some of the best sphalerite is found at the ends. A similar recrystallized dolomite breccia unit over 60 m (200 ft.) thick occurs on strike, and in the same stratigraphic position, approximately 11.6 km (7 mi) north, at the head of Rock Canyon Creek (Figure 4). Here, the unit contains purple fluorite, but no sphalerite was observed.

9. GEOCHEMISTRY

9.1 Middle Cambrian Stratigraphy

A total of 257 geochemical samples, mostly stream sediments, were taken from middle Cambrian stratigraphy during the programme and subsequently analyzed for lead and zinc. The pH varied between 6.0 to 7.4, and averaged 6.5. Regional background values of up to 100 ppm zinc and 30 ppm lead were determined by visual analysis of curves obtained by plotting cumulative percent versus log of metal content (Appendix V). Twenty-three samples were anomalous in zinc, sixteen were anomalous in lead, and thirteen samples were anomalous in both lead and zinc. The locations of these samples are shown in DWG.GC-8602-2. The lead and zinc silt sample anomaly near Lunette Lake resulted in the discovery of the C-1 showing. The other anomalies did not have such high values of lead and zinc, and were not followed up by prospecting during the summer. The C-2, C-3 and C-4 showings were not reflected by stream or silt sample geochemistry, and were found solely by prospecting.

The Shag claims, however, which cover the C-3 and C-4 showings, contain numerous lead and zinc anomalous silt samples that should eventually result in the discovery of more showings on the property (Figure 3).

Four soil samples were taken, and all gave anomalous lead and zinc values. Three were taken at the C-2 showing, and reflected the mineralization very well, being highly

anomalous in lead and zinc. One soil sample, highly anomalous in lead and zinc, was taken about 1.5 km (1 mi) south of the C-1 showing, but at the same stratigraphic position. This indicates that the C-1 mineralization may extend for at least 1.5 km (1 mi) along strike.

The success of these few soil samples in reflecting mineralization shows that it is an effective tool, and should be used extensively in future work to evaluate the potential of the anomalous areas already located.

9.2 Devonian Stratigraphy

A total of 225 geochemical stream silt samples were taken over Devonian stratigraphy during the programme and subsequently analyzed for lead and zinc. The pH values varied between 5.7 and 7.0, and averaged 6.2. Regional background values of up to 300 ppm zinc and 20 ppm lead were determined by visual analysis of curves obtained by plotting cumulative percent versus log (metal) (Appendix V). Forty-two samples were anomalous in zinc, eight were anomalous in lead, and two were anomalous in lead and zinc. The locations of these samples are shown in DWGS. GC-8600-2 and GC-8601-2. It is believed by the writer that a thin, black shale unit of late Devonian to Mississippian age (Exshaw?) is responsible for many of the high zinc values obtained in stream silt samples. This, or a similar, black shale unit was observed on the ridge above the zinc anomalies on the Lussier river, in the areas both to the north and south of Maiyuk creek where many zinc anomalies occur,(DWG. GC-8600-4) and also at the head of

Boivin Creek, where many anomalous samples were found (DWG. GC-8601-4). Extensive follow up work in these areas is probably not warranted, unless barium anomalies are found to coincide in the shales with the zinc anomalies. Analysis for barium is underway at the time of writing this report. Results will not be on hand in time for inclusion here.

The geology around Maiyuk Creek however, is poorly known, and it will be recommended that at least a minor amount of follow-up work be done there to confirm that the shale unit is in fact responsible for the zinc anomalies.

The significant zinc occurrence at Munroe Lake is not expressed very well, if at all, by stream geochemistry. The lack of lead in the deposit makes it difficult to assess the regional geochemical data, as coincident lead and zinc anomalies would normally be looked for. However, it seems that samples anomalous in zinc only may reflect significant mineralization in this belt of Devonian carbonates.

10. CONCLUSIONS

10.1 Shag Property

The Shag property is a promising prospect, because of its mineralization, anomalous geochemical samples, and its location within a unit that contains numerous other Mississippi valley-type Pb,Zn occurrences. Some of these occurrences, such as the Hawk Creek deposit and the Monarch-Kicking Horse mines, have significant bodies of mineralization and since the Shag property is on the same trend there is every possibility that it too contains mineral deposits of significant dimensions. The mineralization in major Mississippi Valley camps, such as Pine Point and Cornwallis Island, occurs along trends that can be 135 km (80 mi) or more long. The Shag property belongs to a similar major trend in the Cathedral Formation, that also includes the Hawk Creek and Monarch-Kicking Horse deposits, and is therefore over 120 km (70 mi) long (Figure 1). Mineralization at these known localities on the trend, occurs as cigar shaped orebodies, that are almost certainly cavern fillings (Figures 11, 12, 13 and 14.) Cavern filling is a feature that separates Canada's Mississippi Valley-type camps into those that are important and those that are subeconomic and adds to the potential of the Shag property, as known mineralization on the trend is of this type.

10.2 C-1 Showing

The mineralized breccia and associated gossan zone seen at the C-1 showing is possibly of significant dimensions, as it appears to be at least 1.6 km (1 mi) long

and in places over 6.0 m (20 ft.) thick. At the C-1 showing itself, the assay values are very low. However, at any point within the mile long zone it is possible that higher grade material can be found. If better-grade mineralization can be located, then the large dimensions of the zone make it a significant and attractive occurrence. Soil sampling would be an effective tool to use along this gossan zone, as one sample taken along it during the summer contained highly anomalous lead and zinc values.(DWG.8602-4).

10.3 C-2 Showing

Both the large number of zinc-containing float boulders in a small localized area at the C-2 showing, and the fact that they show three different types of mineralization, indicate their source to be local. The possibility that glaciers carried all of these different types of mineralized boulders from points unknown, and dropped them altogether in one small area is too great a coincidence for the writer to accept. Many of the pieces, however, appear to be somewhat rounded,indicating that they have been worked by a stream. A small gulley runs down the mountain and through the C-2 showing. The mineralized pieces could have been carried down this gulley from somewhere on the ridge between the Mitchell River and Assiniboine creek, by either stream flow or snowslides, thereby becoming rounded. They could also have been carried by snowslides from the ridge on the west side of the Mitchell river, to where they were deposited on the opposite side of the valley at the C-2 showing. Soil sampling along lines above and below the showing would

be an effective tool in tracing the mineralization to its source, as soil samples taken from the road cut at the showing were highly anomalous in lead and zinc. The showing lies within the claims worked by Placer Development (Figure 2) for magnesite but which are held by a junior company.

10.4 Extensions of the Monroe Zinc Showing

The fluorite-containing breccia zone at the head of Rock Canyon Creek, just east of the DEEP PURPLE claim is almost certainly a continuation of the sphalerite-containing breccia zone at Munroe Lake (Figure 4). The 13 km (8 mi) long belt between the two areas has good potential for further zinc mineralization, but a complete cover of up to 153 m (500 ft.) of glacial drift eliminates the possibilities of investigating it by geochemistry and prospecting. The only possible way to test this zone would seem to be by drilling.

10.5 Fluorite Mineralization

The fluorite mineralization at the DEEP PURPLE claim is identical to that along the Bull River, 42 km (25 mi) away, in that they occupy the same stratigraphic position within the Devonian Succession, and are both associated with a very peculiar, uncommon breccia unit that is not seen elsewhere. This unit shows what are believed to be soft sediment deformation textures in places, and can generally be called a breccia. It is believed to be associated with a gypsum unit, and may have formed as collapses and slumps, where the evaporites have been dissolved away. Finding these

two fluorite occurrences in the same stratigraphic position, indicates that they are stratabound,and opens up possibilities for exploring the entire belt of Devonian rocks for further deposits. Similar breccias are reported to occur in many localities within the Stanford Range around Radium (Belyea and Norford, 1967). It is possible that fluorite could also occur there as well. Alternatively the fluorite may have been emplaced in the gypsum along a thrust fault.

11. RECOMMENDATIONS

11.1 Middle Cambrian Stratigraphy

11.1.1 SHAG Claims

1) The main recommendation would be that a soil sampling programme should be done along the break in slope of every stream that drains the claims. Samples should be taken no more than 30 m (100 ft.) apart.

2) All outcrops on the property should be prospected and all streams and springs should be silt sampled.

3) The area along the south boundary of claim SHAG 4 between posts 3E and 5E should be prospected to locate a copper showing that was reported by one of the stakers.

4) The cliff face at the C-3 showing should be prospected further, and so should the rusty streak

seen above it, a little to the east. Some of the pyrite-containing samples adjacent to the C-3 showing should be assayed for lead and zinc to help determine the extent of lead and zinc mineralization.

11.1.2 C-1 Showing

1) The main recommendation here would be to soil sample and prospect the entire east side of the Assiniboine Creek valley along the lower part of the gossan zone, and its probable strike continuation, from Lunette Lake for 5 km (3 mi), south to the Aurora Creek valley. Sample interval should not exceed 30 m (100 ft).

2) If any indications are found that certain area along the gossan zone contain significant mineralization, then these areas should be trenched to expose the mineralization.

11.1.3 C-2 Showing

1) The main recommendation here would be to soil sample the area around the showing, along three lines, one 15 m (50 ft.) above, one 15 m (50 ft.) below, and one along the road, for a distance of 0.8 km (0.5 mi) on either side of the showing. Further, short, closer spaced soil lines, about 3 m (10 ft.) apart, should be run parallel to the contours, directly above and below the C-2 showing, until all of the boundaries of the anomalous area are defined. Hopefully, this

information will develop a train or pattern of high Pb-Zn values that can be traced back to their source. The ground is held by others because of extensive magnesite deposits (Figure 2). The holders are probably not aware of the Pb-Zn boulders, and if a good Zn prospect is found, it may be possible to option their claims on the pretext of investigating the magnesite.

2) The ridge between the Mitchell River and Assiniboine Creek should be prospected up to the Park boundary and so should the west side of the Mitchell River valley directly across from the C-2 showing, to locate the source of the float boulders, if the soil sampling programme proves inconclusive.

3) A brief look at the airphotos that cover the area may give some aid in locating the source of the C-2 float, as certain geomorphological features may be observed that will show the gravel to be either glacial drift or snowslide and stream debris.

4) An attempt should be made to map this small area.

11.1.4 Regional Work

1) The main recommendation would be to follow up the best anomalous silt samples with prospecting and possibly further geochemistry. These are,

a) The cluster of anomalous samples at the head of Aurora Creek.

b) Sample number 124 south of the junction of Aurora and Assiniboine Creeks.

c) Sample number 52 on the north side of Tangle Peak.

2) A rusty area, at about 6100 feet elevation on the south side of the Aurora valley, directly across from the junction of Assiniboine and Aurora creeks should be soil sampled and prospected, as it may be a continuation of the C-1 mineralized gossan zone (Figure 16). A prospector who investigated it in the summer found much pyrite there and saw an interesting solution brecciated area in a cirque just to the east.

3) The break in slope along the east side of the valley draining into the Albert River from Millers Pass should be soil sampled and prospected, as should the break in slope on the north side of the Albert river directly across from the C-3 showing.

4) The area at the head of Queen Mary Creek contains numerous breccias, and anomalous silt sample number 7725382 and requires further geochemistry and prospecting.

11.2 Devonian Stratigraphy

11.2.1 Deep Purple Claims

1. The main recommendation would be to soil sample the entire drainage of Rock Canyon Creek on a grid, and run the samples for F, Ba, Pb and Zn and do further soil sampling if necessary, to follow any anomalies to source, and hand-trench the best areas to locate the fluorite mineralization in place.

2. Map the Rock Canyon Creek valley, and try to tie the geology into the Munroe Lake stratigraphy in order to relate the zinc containing breccia zone at Munroe Lake to the breccia zone at the Deep Purple claims.

11.2.2 Regional Work

1. Sort out the different Devonian units, by making a number of measured sections in various places, and try to put in facies boundaries, in particular regard to the Munroe Lake showing. It may be possible to determine fore-reef, reef and back reef units.

2. Follow up and prospect the best anomalous zinc silt samples obtained in 1977. Those areas that should be followed up are listed below.

a) All of the anomalous samples in the vicinity of Maiyuk Creek should be investigated. A black shale unit occurs in the area, and probably is responsible for the high zinc values and so intensive follow up work is not recommended.

b) The three anomalous samples that occur along the Bull River approximately 5 km (3 mi) above its junction with Quinn Creek should be followed up carefully. Fluorite similar to that occurring on the Deep Purple claims outcrops along the road here and a minor amount of galena is associated.

c) The anomalies on the creek that drains into Bull River from the east at latitude 50° should also be followed up carefully with prospecting and further geochemistry. A black shale unit which outcrops on the drainage divide at the head of the creek may be the source of the high zinc values. This same black shale unit is believed to be responsible for the anomalies along Boivin Creek. The lead anomaly which occurs here may lead to fluorite mineralization as there are lead anomalies on the Deep Purple claims.

3. Follow up and prospect anomalous F and Ba silt samples obtained in 1977 for fluorite mineralization.

4. Compare stratigraphy at the Deep Purple claim, to that at the Bull River fluorite showing to gain information for fluorite exploration along the entire belt. It is important to know where the fluorite mineralized beds occur in relation to the gypsum bearing beds in these two occurrences, so that it will be possible to predict where the fluorite should occur along the belt of rocks that lies between.

5.The belt of Devonian rocks shown to outcrop along the western edge of Figure 1 and DWG. G-8603, from White Swan Lake to the northern edge of the map, could contain fluorite and zinc mineralization, and may warrant prospecting and geochemistry. It would first be necessary to outline the units on maps more accurately than was done in this report. Breccias similar to those found associated with fluorite in mineralization have been reported from these rocks.

VANCOUVER
April 1978

C. Graf

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